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OBSERVATIONS ON THE SNOWSHOE HARE, LEPUS AMERICANUS PHAEONOTUS ALLEN

BY WALLACE B. GRANGE

[*Plates* 1–2]

The snowshoe hare is one of the most common mammals in the wooded portions of Rusk County, in northwestern Wisconsin. It is also one of the most interesting, and, furthermore, even casual observation of these graceful creatures brings one face to face with many unsolved problems. Consequently a more or less erratic study of snowshoe hares in the wild was pursued while the writer lived in favorable surroundings near Ladysmith, Wisconsin. Afterward, when an opportunity to continue observations under laboratory conditions was presented, particular attention was paid to the pelages and pelage changes of captives. The pelage observations will be presented in a later paper. The present report will put on record a considerable number of more or less unrelated observations made on both wild and captive hares. Wild hares were observed mostly in Rusk, Sawyer, and Door Counties, Wisconsin.

In the course of this informal study many persons have given valuable assistance. It is a pleasure especially to make the following acknowledgements: to Dr. A. S. Pearse, who suggested some of the work and who kindly furnished wire for the first pens; to Mr. E. M. Dahlberg, Principal of the Ladysmith High School, and to his 1926–1927 Zoölogy Class, particularly to Franklin Conwell and Hugo Voight, for trapping and shipping us our most valuable hares; to Dr. Lee R. Dice and the Museum of Zoölogy, University of Michigan, for quarters, feed, and equipment, for the use of photographs, and for other favors;

to Miss Crystal Thompson for photographing young hares; to Prof. George W. Wagner and the Zoölogy Department of the University of Wisconsin for the use of specimens and for other courtesies; to Dr. Adolph Murie for caring for hares during our absence; to Dr. Arthur Svihla, also for caring for hares; to Harry F. Johnson and the Wisconsin Conservation Commission for quartering animals at the State Game Farm and recording data; to the U. S. Biological Survey for the use of specimens and photographs; to my mother, Helen T. Grange, for feeding hares in 1926; and to my wife, Hazel S. Grange, for assistance in anesthetizing and examining hares and for constant encouragement throughout the study.

Numerous difficulties were met in the early course of the study, especially in obtaining live specimens and in keeping them for observation. Trapping proved to be a minor problem, for snowshoe hares readily enter box traps and, in fact, have so much curiosity as greatly to facilitate capture. Hare Number 1 was trapped on January 23, 1926, but died within two days, no doubt from injuries. Number 2 was secured on January 25, but was carried off the following night by a great horned owl. Number 3, caught on January 29, lived in captivity until July 15, when it was mutilated by a stray cat. Number 4 was liberated at once, owing to injuries from which it was more likely to recover in the wild. Hare Number 5 was accidentally caught in a steel weasel trap and was injured so badly that its right front foot had to be amputated. It nevertheless lived from March 9 until June 19, at which time the cause of death was undetermined.

The 1926 efforts showed mainly that the hares were easily trapped and that they would live in confinement if suitable surroundings were provided.

In 1927 a number of hares were trapped and shipped to us, at Ann Arbor, Michigan, by the boys of the Ladysmith, Wisconsin, High School Zoölogy class. The first of these hares, Number 6, arrived at Ann Arbor on March 3, 1927, dead. The second, Number 7, a splendid female hare, arrived on March 5 and became the most valuable of any of our hares, giving birth to two litters of young that season. She lived until October 9, when her hip was accidentally injured after a toenail had caught in the burlap sack in which she was being examined. In spite of a veterinarian's attention she died from the injury several days later. Hare Number 8, the male that mated with Number 7, was received on March 17 and lived in good health until the summer of 1928. Two other hares, Numbers 9 and 10, were received that same

spring but died almost immediately, possibly from injuries suffered in shipment.

Number 11 was born in captivity (offspring of 7 and 8), on July 2, 1927; Numbers 12, 13, and 14 (from same parents) were born on August 18, 1927. All four lived until the following June.

Number 15 was received at Ann Arbor, from Ladysmith, on January 1, 1928, and survived until June 21, during which month most of our captives succumbed.

The other hares used in this study were not given numbers. At least two dozen of these later animals were used, all obtained in Door County, Wisconsin, and held in outdoor pens at the State Game Farm, in Peninsula State Park. Four litters of young were born in captivity from these Door County hares. Several of these young hares were taken for study skins.

The high percentage of deaths that seems to be apparent in the foregoing account does not indicate any inherent delicateness of snowshoe hares as concerns handling, but rather demonstrates inexperience on the part of the handlers. With few exceptions, hares caught during the latter part of the study survived and lived in captivity in apparently good health. Snowshoe hares seem to be well adapted to laboratory use.

HABITATS FREQUENTED BY SNOWSHOE HARES IN WISCONSIN

In northern Wisconsin forests of practically all types are inhabited by the snowshoe hare, whose characteristic runways are to be seen in the winter snows and in the summer sphagnum moss, especially in swamps. In Door County, snowshoe hares are called "Swampers." The amount of underbrush largely determines the desirability of any particular range, and the lack of a goodly proportion of either aspen or balsam fir, or both, seems to be a limiting factor in many cases. Mature woodlands of any type are less frequented than younger and bushier growths which provide both cover and food. In general, the following distinct associations or types are inhabited.

Aspen Areas. One of the favorite habitats of the snowshoe hare in Rusk County, particularly when there is a liberal number of balsams, cedars, and other small bushy conifers scattered through aspen woods of moderate age. Aspen woods adjacent to coniferous swamps afford excellent snowshoe range.

Coniferous Swamps, even without aspen, seem to be used all the year round by hares, but the occurrence of sandy "islands" or "hogbacks" covered with aspen is no doubt advantageous. About such places the snowshoe hares may be found in summer in the raspberry tangles, or wallowing in the dust of uprooted trees. The alder, aspen, and miscellaneous growths that frequently form a fringe about coniferous swamps are important.

Hardwood Forests seem extensively used only if there is some small coniferous cover and some brush. Hares do not seem to reach any great abundance in strictly hardwood areas.

White Cedar growing over the upland limestone formation of Door County is frequented in numbers, regardless of whether the upper or crown growth is deciduous or coniferous. Wherever the cedar grows in young or open stands one may look for snowshoe hares with considerable probability of success.

Mature Hemlock stands in Sawyer County are inhabited by Snowshoe Hares, but in such localities it is not far, generally, to patches of other forest trees, such as black spruce in the pockets and various aspens in the burns. Hares do appear, however, to spend some time even in the relatively "brushless" areas beneath the giant hemlocks, though in very moderate numbers.

Alder Swamps constitute a favorite resort for hares. They also range out into willow swamps, as noted frequently along the Little Thornapple River, in Rusk County.

Old Burns containing a profusion of raspberry tangles, fallen logs and limbs, aspen shoots, and other vegetation are extensively used. The burns in northeastern Rusk County were being used by hares in July, 1921, far from any true forest growth.

Young Jack-Pine Areas appear to be used by hares, especially in conjunction with aspen, but the older stands contain few, if any, snowshoes. This condition no doubt applies also to other species of pines.

Aside from the southwestern Wisconsin oak territory, which is lacking in conifers and swamps, and about which we are in ignorance, the snowshoe hare seems to occur in practically all the forest habitats of Wisconsin, in some locality or other.

An interesting observation is that snowshoe hares can occupy fairly mature woodlands if beavers are present. They make use of a good deal of waste left by beavers, frequently utilizing low-lodged trees which become available as snows deepen. We have observed hares in some concentration about beaver cuttings of aspen, alder, and willow.

There is no doubt a great variation in the attractiveness of certain of the forest habitats during the different seasons. It is evident that swamps and clumps of upland conifers are of increased importance in winter, and that some aspen woods that are deserted in winter are inhabited in summer; but beyond this rather vague statement we have no very tangible conclusions. In fact, snowshoe hares are extremely difficult to find in the summer months, and their habits from June 1 until September 1 are relatively unknown.

TERRITORIAL PREFERENCES AND CRUISING RADIUS

Our captive hares showed a definite partiality for certain spots and corners to which they became accustomed. At Ann Arbor the hares were quartered in the rooms of an old frame residence. When a door to one of these rooms was temporarily left open, the hares generally wandered out into adjacent rooms, inquisitively poking about in odd corners, boxes, etc., but at the least sound of danger, imaginary or real, they would bound back to their usual room, often to their favorite corner. This was noted again and again. They might easily be induced to change rooms, whereupon they would later forget the old corner and retreat to the new one, but unless disturbed they appeared to have a definite place they considered their own. A hare's familiarity with its immediate surroundings was accurate; the animal seemed to know just how many jumps were needed to get back home in the quickest time and by the shortest route.

The sovereignty of an individual hare's territory is less evident, and we cannot offer much on this point. As will be mentioned elsewhere, the female would not allow the male in her territory (cage) during late pregnancy and the males themselves were quarrelsome during the breeding season. Yet in 1926 we trapped five hares in the same box trap without moving it, all in a period of a few weeks, and it is common enough to see from three to five wild hares in the space of an acre. Our opinion is that there are periods (breeding season for males and during pregnancy for females) when definite hostility to other individuals is shown, but that ordinarily snowshoe hares are indifferent to one another, or even possibly gregarious.

As to the individual range, or cruising radius, of the snowshoe hare, we have a few observations (obtained by going out in a snowstorm, starting a snowshoe from its form, and doggedly following this one track) that at least give an indication of its range. Since old tracks filled in with snow almost immediately, it was possible to follow one individual with accuracy until its trail became confused with that of another animal.

On April 11, 1922, for instance, I followed one hare for an hour and fifteen minutes, during which time it could not be driven from an area perhaps ten acres in extent, and in which time it returned to within five feet of the original starting point. This animal, which was finally collected, contained embryos. I have followed several other hares at various times, and with similar results, mostly in spring when faster time could be made.

Hunters who use dogs generally share the opinion that it is difficult to drive hares out of a very restricted territory. In walking "rabbit drives," without dogs, hares are constantly turning back, dodging between the drivers.

In early spring, however, it is not uncommon to find snowshoe hare tracks far from the usual haunts of these animals (half a mile, perhaps) and where no tracks have been observed in several months. Trappers have told me of hares crossing lakes two miles wide. Tracks are sometimes seen on the ice of Green Bay, immediately off-shore, but how far out the hares venture is not known and it is difficult to determine owing to constant drifting and obliteration of the tracks. Hares occur on several small islands in Green Bay, several miles from the mainland. How they got there is not known.

It is regretted that tagging of wild individuals has not yet been possible. It is, however, a method well adapted to field use with hares as they are easily recaptured by nets and live traps.

MATING BEHAVIOR

In captivity the mating behavior seems to consist of a chase in which the male pursues the female until she becomes sufficiently receptive. On July 12, 1927, a successful mating occurred after such a chase had been in progress intermittently for two or more hours. When introduced into the female hare's room, male hare Number 8 was at first repulsed by the female's grunts, general demeanor, and unfriendly attitude. The female (Number 7) dropped defensive tactics almost at once, however, and was then pursued until she attempted to avoid the male by sitting down. The male then hopped to her side and severely butted her about the ribs and abdomen with his nose. This happened a number of times before copulation occurred.

During the two pregnancies of this female we noticed a very definite hostility

to the male, increasing in intensity until at the time the young were to be born the female would fly into a terrific rage if the male was placed with her. On at least two occasions the male would certainly have been killed by her had we not removed him almost at once. As it was, several mouthfuls of fur were bitten out of his back. In 1930, however, a male was kept in the same cage with a pregnant female until the birth of the young, with no harm to the male, although it is worth noting that the cage was large and the male could no doubt have escaped if pursued.

FIGHTING AMONG MALES

Captive male hares when allowed together during the breeding season were extremely pugnacious and fought vigorously. The combats were never allowed to continue very long as we were afraid serious damage would be done, but enough was observed to indicate conclusively that male hares, during this season at least, do not get along together. Fighting was done largely with the teeth. A young captive-born hare was the master of any wild hare we had.

RELATION OF MALES TO YOUNG

Our information on the relation of the males to their offspring is somewhat inconclusive. On some occasions males appeared to pay little or no attention to young animals when placed in the latters' cages. At other times mild interest and hostility were displayed and in one case a young hare learned to retreat to safety whenever the old male appeared.

In 1930, a pair of adult hares was kept together until the young were born. Within a few hours two of the four young were discovered dead, having apparently been killed by the male, although this was not directly observed. It would appear probable that the male and its offspring are not compatible under wild conditions; they certainly were not friendly in captivity.

THE BIRTH AND CARE OF THE YOUNG

The literature contains very little information concerning the manner and place of birth, the condition of the young at birth, and the relationship of the parents to their offspring. Audubon and Bachman (Quadrupeds of North America, 1848, page 98) state in reference to the snowshoe hare: "One had four, and the other six leverets, which were deposited on a nest of straw *the inside of which was lined with a considerable quantity of hair plucked from their bodies*" (italics ours); and in another place on the same page, "the young, at birth were able to see. They were covered with *short hair* and appeared *darker* in colour than the adults at that season. They left the nest in ten or twelve days, and from that time seemed to provide for themselves and to derive little sustenance or protection from their mothers." (Italics ours.)

These authors record that hares of other species were confined in the pens used for their captive snowshoe hares, among the species being the "common European rabbit." Unless, owing to this mixing of species, a mistaken identification of the young was made, or unless actual hybridization occurred, the present writer is unable to reconcile the foregoing account with his own recent observations, as will appear later.

Another author, Cory, in his Mammals of Illinois and Wisconsin (1912, p. 264), states: "The nest is a mass of grass covered with soft fur supplied by the mother. It is usually well concealed under a bush or in a thick growth of weeds, and on one occasion I found one at the base of a hollow tree."

The present writer has talked with many field mammalogists, hunters, trappers, and others, and has in no instance been able to discover an authentic record or observation indicating *any* definite nest. Many have caught extremely young snowshoe hares, obviously but a few hours old, but none, to his knowledge, has discovered a nest about which no question can be raised.

In the course of the present study, six litters of young snowshoe hares were born in captivity and in no case was any nest made by any of the parent hares. The young were dropped on hay or straw litter, in the case of female hares confined indoors, and on the ground or on grass in the case of hares confined in large pens out-of-doors. At no time was there the slightest evidence of any tendency to pluck hairs for use as "lining" nor was there any activity which could reasonably be construed as nest-making. The young themselves, after birth, sometimes hollowed out little temporary places in the litter and they did show attachment for local surroundings, but this the writer would class as equivalent to the use of "forms" in the case of adults.

The possibility that snowshoe hares do build nests for the birth of young under wild conditions still remains, yet the probability seems certainly much diminished in view of the above observations.

Since so little is known about the early life history of these hares, and about parental relationships to the young, a detailed account of the birth of the first young will be given.

On July 2, 1927, female hare Number 7 was noted as quiet but her behavior was not otherwise different from usual at the time her cage was cleaned at 1:30 p.m. We had given up hope that this hare was pregnant some little time previously. At 3:45 p.m., however, she was nosing and licking a new-born youngster, which was still damp. There was no other external evidence of the birth. The old hare was, however, observed to hop more freely, to "hunch up" frequently as if in pain, a sort of convulsion of the hind parts of the body with no movement of the fore parts. Early in the afternoon this hare drank a quantity of water, but this was not unusual and had occasioned no particular comment.

A second litter (this time of three young) was born to this same female (Number 7 mated with Number 8) on August 18, 1927, and on this occasion the female's pregnancy was known and the birth of the young expected so that better observations were possible.

The pregnant hare was given to using one spot in the room, returning to it after being disturbed. In the several days immediately preceding the birth of her young on August 18 she lay down a great deal, being very heavy, but rose up to stretch at frequent intervals. During the last few days of her second pregnancy she showed hostility toward her youngster born on July 2. During the last two days the old hare scarcely moved from her favorite corner at all, at least not while we were present. Movement of her unborn young was plainly evident. It would seem that a hare at this period of pregnancy would be at a very serious disadvantage if surprised by an enemy. She had not attempted any long hops for days, and had refrained from leaping up to the window sill on which she had formerly

delighted to sit for hours basking in the sun by day or in the cool night air at evening, since the window opening was covered merely by poultry netting.

The three young were born in the night or early morning hours of August 18. At 3:30 p.m. of that day the old hare was observed sitting in her accustomed place on the window sill, while her three young were huddled together on the opposite side of the room.

Returning now to the young hare born July 2, a summary of our day to day observations may be of interest.

First Day: Hare born between 1:30 and 3:45 p.m. Still moist at 3:45; old hare licked it from head to foot, very roughly. The appearance of the young hare was pretty much that of a mass of gray fur, although upon close examination its large blunt head and short ears appeared noteworthy. The fur was very heavy and long (as long as three-quarters of an inch), and the animal was distinctly *lighter* in surface cast than the adult. (See earlier statement of Audubon and Bachman mentioned on page 6.) The young hare's feet were small, and it kept them out of sight. At 5:30 p.m. the young hare ran (did not hop) for about five feet. Showed definite fear (by starting visibly) at any sudden noise. Old hare sat with her young under her belly, between her great hind paws.

Second Day: At 11 a.m. young hare hopping about; able to make rather fair progress; also crawled, on all four feet, standing on them and walking on the toes, like a dog; wide awake; turned head from side to side; appeared observant; started when picked up; preferred to hop and crawl into a dark place in the closet of the room. When the door was first opened the young hare was in this dark place, the old hare sitting alone outside.

After our handling of the young hare, the old one first sniffed it, then "snorted" (a definitely expulsive kind of sound) and jumped at it three or four times, but finally accepted it.

Third Day: Hopped vigorously; attempted to crouch low and lie flat when approached; seen near its mother; hid in a box when I tried to capture it; also crawled and wriggled under some hay.

Fourth Day: Sitting a few inches from its mother when first observed. She accepted the youngster without snorting when it was returned after being handled. Young hare watched all that happened near by with a lively interest; washed nose with fore paws much as adults do.

Fifth Day: Sat about three feet from its mother; hopped with more vigor and speed, but still somewhat clumsy. When interested in something it sat with head up and ears pricked forward. Until this date it had not been observed to raise the ears, having kept them held tightly against the body. Hare placed in sunlight for 15 minutes.

Sixth Day: Sat close to its mother; very lively; almost able to hop over an eight-inch wire enclosure when placed in the sun for half an hour; scarcely still a second; hopped back and forth in effort to get out. Showed definite habit (repeated some 20 times) of hopping rapidly toward any little noise or motion such as scratching fingers on wire. Sometimes struck my hand with its front feet at such times, much in the manner of the adults. Female hostile and extended her fore paws angrily when the young hare returned to her.

Seventh Day: Hopped over a food dish; weighed for first time, showing great displeasure and struggling madly; made several little low-pitched grunting and

chuckling noises; when cornered, struck feebly with the fore paws; no attempt at biting; hopped very well; I certainly could not have captured it in the woods with any ease. Sometimes stood attentively, ears up, on the toes of all four feet, leaning forward as if in indecision.

Eighth Day: Tried to bite my finger when picked up; nibbled at the floor of its cage; also ate some lettuce; washed face, legs, sides, and feet after I had handled and rumpled it; hopped and crawled (definitely crawled) to its mother, attempting to get under her. She mildly protested by extending her feet and snorting softly. The young hare was persistent. The mother then hopped away and the youngster nibbled lettuce. Placed in sunlight for 45 minutes.

Ninth Day: Very lively at 2 p.m. I could scarcely have caught it in the woods under ordinary circumstances. Sat in its corner quietly when not bothered.

Tenth Day: It had taken a fancy to sitting for long periods between the scales and the wall, in a little space only two inches wide. It ran to this place, and also to the dark clothes closet, when chased.

Eleventh Day: When the young one was replaced in the room after having been kept from the old hare for two hours, the female seemed immensely pleased. She licked the young hare from tail to nose, rather roughly. The youngster squatted down, half closing its eyes; then wiggled in between her forelegs, from in front, apparently in response to a gentle push on the rump from the mother's nose. With its head tilted to one side, it proceeded to suck noisily, using two mammae before it became satisfied. Meanwhile the mother continued the cleaning process, especially licking the rump and tail region. After about five minutes the female hopped to the dark closet, the youngster following. The young hare stayed there and the female came back into the room to eat rolled oats.

The young hare nibbled hay on this day; also ate a pinch or two of earth. (A supply was always kept available as the hares liked to sit upon earth.)

Twelfth to fifteenth Day: Ears growing rapidly; hare hopped with considerable strength.

Sixteenth Day: Toddling babyish method of locomotion now gone. Jumped in good-sized leaps, very much as adults.

Twenty-first Day: After being chased (it did not allow one to approach), it often turned about, face toward the pursuer and struck vigorously with the fore feet. When stroked gently, however, it settled down and remained quiet. Showed excellent use of ears, pricking them forward as the adults do and sometimes moving one ear at a time. All its actions now were quite similar to those of its parents.

Twenty-second to thirtieth Day: Very hard to catch; only rarely seen to sit with its mother at this time; usually sat upon a patch of dry earth with the mother sitting on a similar patch across the room; both prefer earth to hay.

Thirty-fifth Day: When accidentally grasped by a hind leg, the young hare screamed with almost exactly the same cry as is used by old hares in distress—very loud, drawn-out, and plaintive. After screaming, ran to its mother, which sniffed young hare's nose. On the thirty-fourth day, noted that old hare now paid but scant attention to the young one, although she was not hostile. (Old hare pregnant.)

Thirty-sixth Day: While we constructed a partition in the hares' room in anticipation of the birth of more young, both went about their affairs unconcernedly.

Old hare seen to hop to youngster, push it gently with her nose as if she wished it to move, whereupon the young hare nosed its head in between the old hare's fore legs, at which the female hopped away. The young hare persisted and finally succeeded in wriggling between her front legs and the mother than raised up to assist him. Little hare lay upon its side, sucking with a loud noise and using at least two and probably four mammae, one after the other. Its head was nearly upside down. Old hare during this procedure kept licking the youngster's back, and thoroughly cleaning the anal region. Old hare hopped away two or three times, always followed by the young one, for the small hare was then so large it required quite an effort on the part of the female to hold the necessary position. Young hare sometimes thrust its head in between front and hind legs from the side, sometimes from in front. The nursing period was terminated by the female's hopping away, after which the youngster washed its fore paws, sitting up on its haunches to do so. The two then sat quietly for some time.

Thirty-seventh Day: Ate quantities of greens, as it had done for some time. Dandelions were preferred to anything else available. All the dandelions the hare would eat were supplied daily, and both young and old relished them more if they were moistened with cold water. The old hare seemed inclined to disown the young one today.

Thirty-eighth Day: Jumped high into the air when chased.

Thirty-ninth to sixty-first Day: During this period the young hare continued to develop rapidly. It was captured once a day, and sometimes oftener, for weighing and examination. It never got tame, however, and the more it was handled the more it seemed to resent the whole procedure. When not picked up it was tame, and would eat from the hand.

Of interest was an apparently learned habit. We generally put the young hare in a sack and then worked it carefully out of this and into a small wire receiving cage, about 3 inches high by 5 or 6 inches wide, and about a foot long. It had only one entrance, and the young hare at first had to be poked and pushed to make it emerge, backwards, after it had been weighed. After three or four times, however, the mere click of the door opening the cage so it could emerge caused the hare to turn about and scramble out of its own accord. The click of the opening door thereafter was a signal that was almost always obeyed.

After the second month of life, the hare was in general appearance, and certainly in actions, very much like its parents, except that it grew to be a larger and stockier animal. From this time on it was anesthetized (with ether) frequently to permit pelage examinations, but this rather severe treatment did not, apparently, interfere in the least with its further growth and development.

Observations on the other litters of captive-born hares, while not so systematic, corroborated the above observations in all essential details. The three born August 18 continued to suckle for more than six weeks, and probably did so up to fully two months of age, although they also ate quantities of lettuce, dandelions, rolled oats, etc. All three frequently suckled at the same time, one lying upon its back with hind feet stretched out between the old hare's front legs, the others one on each side of the parent. The young sat both separately and together, generally a few yards away from the mother.

THE RATE OF GROWTH OF HARE 11

Male hare number 11, born July 2, 1927, attained approximately adult weight at two months of age, but continued to increase in weight very gradually from that time until the age of five months, and probably longer. Daily weights are shown in the table below.

The average daily gain in weight for the 159-day period during which records were kept was 9 grams. During this period the young hare approximately doubled its birth weight at 8 days of age (from 85 to 170 grams); doubled this at 16 days (170 to 337 grams); doubled again at 38 days (337 to 667 grams); again at 67 days (667 to 1,398 grams); but from the 67th to the 159th day it gained a total of only 120 grams, or less than 9 per cent of its weight at 67 days.

The weights of adult hares, in the case of specimens from Rusk and Door Counties, Wisconsin, ranged up to 1,733 grams, the heaviest weight we have recorded. The average northern Wisconsin hare will probably run from 1,400 to 1,600 grams.

In the case of a subnormal captive-born individual 1,038 grams was the adult weight. This, however, is definitely below the minimum weight to be expected from normal wild individuals.

Growth Table

Snowshoe Hare number 11, male, born July 2, 1927, captive, from wild-trapped parents, hares number 8, male, and 7, female*

DATE	WEIGHT	DATE	WEIGHT
	grams		*grams*
July 2	85.0†	July 30	812.5
July 8	135.0	July 31	838.0
July 9	145.4	August 1	838.0
July 10	170.1	August 2	837.0
July 11	184.5	August 3	840.0
July 12	209.5	August 4	838.0
July 13	233.8	August 5	590.5
July 14	248.7	August 6	600.0
July 15	270.7	August 7	610.0
July 16	291.0	August 8	628.0
July 17	324.8	August 9	614.5
July 18	337.0	August 10	640.0
July 19	357.8	August 11	643.0
July 20	376.7	August 12	630.0
July 21	387.7	August 13	607.2
July 22	412.0	August 14	620.0
July 23	437.7	August 15	667.0
July 24	487.5	August 16	723.3
July 25	490.0	August 17	786.0
July 26	500.0	August 18	759.0
July 27	524.2	August 19	750.6
July 28	543.2	August 20	790.0
July 29	561.0	August 21	792.2

Growth Table—Concluded

DATE	WEIGHT	DATE	WEIGHT
	grams		*grams*
August 22	862.0	September 8	1,064.0
August 23	845.3	September 9	1,150.0
August 24	883.0	September 10	1,130.0
August 25	894.5	September 11	1,193.0
August 26	936.0	September 12	1,157.0
August 27	910.0	September 13	1,214.0
August 28	916.0	September 15	1,207.0
August 29	916.0	September 16	1,123.0
August 30	942.0	September 18	1,232.0
August 31	960.0	September 25	1,279.0
September 1	963.0	September 26	1,229.0
September 2	937.0	September 27	1,257.0
September 3	947.0	October 15	1,398.0
September 4	984.0	October 22	1,428.0
September 5	988.0	November 1	1,440.0
September 6	1,000.0	November 10	1,433.0
September 7	‡	December 7	1,518.0

Note: Three young hares born on August 18, 1927, weighed, twelve hours after birth, 75.3, 75.4 and 80.4 grams, respectively.

* Male 8 weighed 1,453 grams; female 7 weighed 1,598 grams.

† Birth weight is estimated. All weights from July 8 on are actual weights. Weighing was not done at any regular hour of the day.

‡ Not weighed.

GESTATION PERIOD

Audubon and Bachman in their Quadrupeds of North America (page 98), state: "The period of gestation in this species is believed to be (although we cannot speak with positive certainty) about six weeks."

In the course of the present study we determined the gestation period to be 36 days, or perhaps a few hours longer. Specifically, mating occurred between the hours of 5 and 10 p.m. on July 12, and the three young were born on the night of August 17 or early in the morning of the 18th.

SIZE OF LITTERS

Six litters of young were born to our captive hares, with dates and numbers of young as follow: July 2, 1927, 1 young; August 18, 1927, 3 young; June 25, 1930, 4 young; July 14, 1930, 4 young; August 21, 1930, 3 young; April 27, 1931, 3 young. Four embryos were found in a female taken on April 11, 1922.

As has been noted, one captive female produced two litters during the same summer. Whether or not this occurs in a state of nature we do not know.

THREE POSES OF SNOWSHOE HARE DURING LATE WINTER

FOOD HABITS

Snowshoe hares in the wild state live largely on succulent vegetation in the summer period, and upon buds, twigs, and bark during the winter. They have a special fondness, in winter, for various species of aspen, and are in the habit of girdling many trees and of eating the bark from every available limb of fallen aspen trees. They browse about coniferous trees a good deal, eating the ends of low hanging branches, or nipping seedling trees, a habit which has brought these animals into some disrepute among foresters. In the summer we are certain that hares eat the jewelweed (*Impatiens biflora*) which grows so abundantly about the borders of swamps and in other moist places. They are also fond of the common dandelion (*Leontodon taraxacum*) and of various clovers (*Trifolium* sp.) that grow along roadsides through forest regions.

We have seen evidence that wild hares eat the following: White pine (*Pinus strobus*), tamarack (*Larix laricina*), black spruce (*Picea mariana*), hemlock (*Tsuga canadensis*), balsam fir (*Abies balsamea*), white cedar (*Thuja occidentalis*), American aspen (*Populus tremuloides*), willows (*Salix* sp.), birches (*Betula* sp.), the buds and branches of fallen paper birches (*Betula papyrifera*) and tag alder (*Alnus* sp.), and shoots of wild red raspberry (*Rubus strigosus*), and wild blackberries (*Rubus* sp.). The list of plants eaten is no doubt large. Little is known of the summer foods taken.

We noted damage to white cedars (*Thuja occidentalis*) on one of the Strawberry Islands in Green Bay, Door County, Wisconsin, in January 1930, at which time the hares were not only eating such twigs as were within reach but were actually eating the inner bark from the boles of good-sized trees. The outer bark was spit out. This probably is an unusual habit. The animals were very numerous on this small island and were no doubt hard pressed for food.

Our observations on wild hares in general do not indicate any seriously detrimental effect of snowshoe hares upon natural growths of forest trees. The hares act as thinning agents, it is true, and do kill many trees, but most of these would no doubt die even if it were not for the hares. Trees are seldom killed out in any considerable patches, as the habit of snowshoe hares seems to be that of picking here and there rather than making a clean sweep of any one locality. The nipping off of terminal shoots of coniferous trees might occasionally do harm under natural conditions, but the observed instances of serious damage have all been upon artificial forest plantations, invariably in the solid stands. The fact that snowshoe hares are capable of seriously damaging forest nurseries should not distort our perspective in dealing with these interesting and useful animals in natural forests, where they may be considered as neutral in effect. The finest examples of natural coniferous forests are often to be found in regions that must have been inhabited by snowshoe hares for many centuries, a fact that would indicate a satisfactory adjustment in a state of nature. The objective of wild-life students should be to develop artificial methods of forest reproduction, if necessary, along lines adjusted also to the native creatures of the region, rather than to undertake the elimination of creatures that may become destructive under highly artificial conditions.

In captivity a wide variety of foods were accepted by our hares, among which dandelions were preferred above all others. Aspen ranked next, and following this

came almost any green deciduous leaf or bark. We did not have opportunity to determine the order of conifer preferences. Apples, pears, carrots, celery, cabbage, corn, cornmeal, oats, lawn grass, sorrels (*Rumex* sp.), and clovers were eaten readily. Lettuce was eaten, but spinach was invariably refused. (It is interesting to note that captive cottontails (*Sylvilagus*, several species) kept in the same building by Dr. Lee R. Dice showed no aversion to spinach.)

DRINKING

Seton (Life Histories of Northern Animals, Scribners, 1909) states: "The young snowshoe will drink milk in quantities, but, so far as known, the adult never drinks anything."

Our captive hares however, drank water frequently. The pregnant females drank large quantities, and all the hares, young and old, relished their green stuffs more if these were well wetted down with water.

CALLS AND SIGNALS

Snowshoe hares do a good deal of thumping with their great hind feet, but just what the significance of these "signals" is we have not ascertained. The thumping does not seem to be confined to either sex or to any particular season, except as snow may interfere.

The hares were noted to make a kind of grunting noise of displeasure at times, and the female hares made use of a "snort" which seemed to be a kind of reprimand or evidence of disgust most often used when a young hare that had been handled by a person was returned.

Frightened adult hares when grasped by the hind legs and lifted from the ground, utter a very loud, piercing, and plaintive scream, almost a bleat. The same cry is given by mortally wounded hares. It is said that hares captured by enemies have been known to utter this scream, and we ourselves have heard it in the middle of the night in the northern woods although careful search never revealed either the hare or any evidence of a struggle. I have seen boys drop a screaming hare which they were holding, but, although in this case the scream had some survival value, it seems to be a scream of terror rather than of defense.

THE USE OF FORMS

Snowshoe hares make regular use of "forms," or beds, which are to be found throughout the year. They are sometimes sheltered by sedges or grasses, by fallen tree tops, by low hanging branches, or are located in the nearly impenetrable thickets of burned alder, but they may, on the other hand, be found also in fairly open situations. Sometimes one all but steps upon a hare before it leaps from a well-concealed bed. In my experience this happens most often in recently burned areas, where an abundance of ground cover has freshly grown up.

The hares are very fond of resting on top of logs, knolls, or other elevations, especially in winter, when they may sit for long periods in what would be conspicuous situations if it were not for their protective coloration. In late winter they seem especially to like hillsides that get the full strength of the sunlight, while in late summer much evidence of their resting places is to be found in dense growths of jewelweed.

Snowshoes may often sit through storm periods without moving, and follow-

ing these and other periods of inactivity it is common enough to find hollows melted in the snow and lined with ice in which are embedded quantities of guard hairs, the body heat of the animal having melted the snow, which froze immediately after the hare left. In late winter, when the guard hairs are very loose, such forms may appear to be lined with fur.

THE USE OF DENS AND LOGS

It has been commonly thought that snowshoe hares do not use either dens or logs. Thus, Audubon and Bachman in their Quadrupeds of North America, 1846 vol. 1, p. 96, state: "The assertion of Warden, that the American Hare retreats into hollow trees when pursued, applies to the grey rabbit, for which it was no doubt intended, but not to the Northern Hare. We are not aware that the latter ever takes shelter either in a hole in the earth, or in a hollow tree. We have seen it chased by hounds for whole days, and have witnessed the repetition of these hunts for several consecutive winters, without ever knowing it to seek concealment or security in such places. It depends on its long legs, and on the thickness of the woods, to aid it in evading the pursuit of its enemies."

In Rusk County, Wisconsin, however, we have found snowshoe hares making frequent use of hollow logs and occasionally entering old woodchuck dens in the earth. In much of the northern Wisconsin territory a thick growth of aspen now conceals the fallen, and often hollow, boles of the former white-pine forest. There is abundant opportunity for the use of hollow logs in this region, but it is obvious that in virgin forests the opportunities would have been much less frequent.

Hare number 8 of this study was taken from a hollow white pine-log by Franklin Conwell. I have often captured hares in this manner myself and, as boys, we used to have a whole series of logs that we visited on our hunts for the purpose of ramming poles through them in order to get shots at whatever might be within. We thus routed not only cottontails and snowshoes, but a mink, several house cats, and numerous woodchucks, porcupines, squirrels, and other temporary occupants. It was common enough to find one species in a log today, another tomorrow. Probably many of the snowshoes dodge into logs when closely pursued by natural enemies just as we have seen them do when chased by fast dogs.

As to the use of ground dens, we knew a spruce swamp, set in a pocket between rather steep clayey hills or banks, that was much used by snowshoe hares which went in and out of woodchuck dens dug in these banks. Such favorable situations may not be particularly common, but in the case mentioned, the hares entered the dens even when not pursued by enemies, as could be determined from tracks in the snow.

THE USE OF RUNWAYS

The runways of the snowshoe hare are conspicuous, especially in swamps, in winter when the trails, like complicated highway systems, transect certain areas in all directions. Some are little used; others are packed firmly from constant use both by the hares themselves and by many other animals that have taken advantage of them. Where the hares have fed for any length of time, the snow may be packed down for several square yards and runways may be very numerous.

But the snowshoes do not necessarily need to use a runway; they can leave it

and hop out over the soft snow at any point with comparatively little inconvenience. Snowshoe hares can travel over loose snow in which cottontails would flounder hopelessly; the gigantic hind feet of the snowshoe being particularly adapted for speed and efficiency under such circumstances. In very wet snow even the hares may sink down, but in such times they prefer to "hide up" temporarily, only venturing out when the setting sun has brought temperatures sufficiently low to form a slight crust, over which they then race with abandon. Few mammals seem better equipped for the environment in which they live than these hares, and their adaptations are particularly impressive when observed in midwinter, as one perhaps clumsily pursues them on foot or upon his own much less effective snowshoes.

Runways are used at all seasons of the year as a matter of convenience, and the runs may be used year after year until definite troughs or lanes are worn through the sphagnum moss. Many hares are snared for meat or fur or to be used as bait in the trapping of other animals. With a few strands of wire it is not difficult to snare hares in favorable country, and they can sometimes be driven into snares which have just been set. The possibility of wholesale netting for the purpose of tagging and releasing is at once apparent.

THE USE OF DUST PLACES

These hares delight in wallowing in dusty places about old logs, in paths, or anywhere that fine dust is to be found. These "dust baths" are to be found all through the summer months and can be recognized by the tracks and by the hairs that are often found in the dust. Our captive hares made great use of dirt provided for dusting purposes.

In this connection it is interesting that the ruffed grouse and the snowshoe hare may use the same dust wallow, for we have found the hairs and feathers at the same spot. The possibility of parasite transmission between bird and mammal is to be noted.

ATTITUDES AND POSES

The snowshoe hare in many of its poses is a thing of graceful beauty. In others it is comic. But in all of the common attitudes taken agility, litheness, and coördination are apparent to a remarkable degree. Some of the poses are grotesque but none could rightly be classed as clumsy. The grace and beauty of these creatures might inspire an artist as that of few mammals would.

The hares spend a prodigious amount of time in grooming the fur, washing and smoothing it for hours on end. The ears are carefully combed and the feet are licked and cleaned methodically. In washing the ears the hare sits upon its great hind feet and with the fore paws pulls the ear down next the cheek; the fur is then smoothed both by raising the head, thus drawing the ear between the paws, and by pulling the paws down the ear. The fore paws are well padded with long, coarse hairs that serve very well for brushing purposes. The feet are licked with the tongue, after which they may be used in rubbing the face with a rotating movement of both face and paws. The legs, chest, and shoulders and the dorsal area are given frequent grooming in systematic manner.

In cleaning the hind feet a very grotesque position is assumed: Sitting high up, with both fore feet upon the ground in an almost vertical position, a hind leg

and foot with toes widely stretched apart, is extended far out in front of the hare, where it is thoroughly washed and smoothed by the tongue. This and the combing of the ears are perhaps the two most interesting poses taken in the grooming process.

Snowshoe hares often sit quietly with the feet entirely out of sight, tucked in under the belly fur, and with ears pressed tightly against the back, a position which has no abrupt lines and which is effective in giving concealment to the animal in the wild. The raising of the ears is enough, frequently, to attract attention, and with them erected the hare is much more easily seen even though no movement has been detected. Hares also sit up on their haunches, like dogs, lie down either on the belly or on the side, and assume about the same positions as are commonly observed in domestic rabbits.

The wild hares can, however, stand upon their outstretched hind feet with the fore legs and feet limp, with apparent ease. They often feed in this manner, standing up to reach twigs and buds, or bracing against higher limbs with the fore feet in an effort to reach some delicacy.

In hopping, the fore feet are held very close together, the hind feet widespread as is the case with other hares and rabbits. Snowshoes show particular agility in turning in the air.

Our captive hares often grasped objects with their teeth. On several occasions we saw them drag fairly heavy feed dishes half way across a room although there seemed to be no special reason for doing so. When in anger, hares often tugged at wire or clothing.

CURIOSITY

Curiosity was a trait well developed in our captive hares, which showed a propensity to investigate anything and everything that happened to be about. Often it seemed that a hare had difficulty in not permitting curiosity to overcome fear. Shoes, clothing, boxes, scales, and other objects were almost immediately inspected, perhaps taken in the mouth, and sometimes chewed.

POPULATION FIGURES

It is well known that the numbers of snowshoe hares are at times subject to great fluctuations. As to population per unit area, Seton states that one hare to a square mile is scarce, and that 10,000 to the mile is the maximum. We have never encountered anything approaching the abundance mentioned by Seton and many other writers. Some of the Wisconsin hare country no doubt fell to the minimum of a hare to the square mile, however, in the last low period, which, near Ladysmith, was most pronounced about 1927 and 1928. Yet even in that locality, where there was a general shortage of "rabbits," there were places of local abundance or "normal" populations, as was indicated by tracks. In Door County, in Peninsula State Park, hares were very uncommon in 1928, although a few tracks could be found that winter (1928–1929). They have steadily increased from that date to the present time. In 1930 many were captured in box traps and also incidentally in other trapping operations near the State Game Farm. They are still abundant in 1931, and they appear to be increasing.

The only definite population figure we have been able to obtain is that for one of the Strawberry Islands, an island of about 40 acres located in Green Bay, op-

posite Fish Creek, Door County, Wisconsin, where in December, 1929, local hunters are said to have killed 18 of these hares. I visited the island after this hunting had taken place and found a considerable number of hares there; certainly as many as had been killed. It is at least safe to say that there was one hare to the acre on this island in December, 1929. The island is about a mile off shore. There is no known evidence of migration to or from the island and the history of the hare population since 1929 is not known.

DISEASE

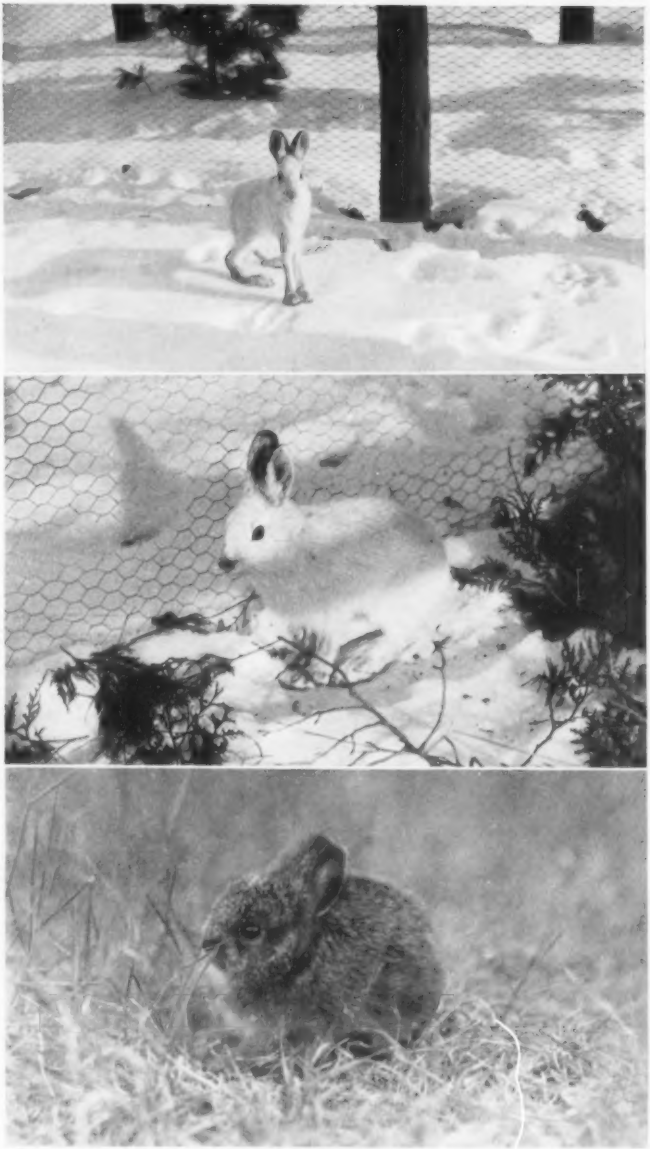
Our 1927 and 1928 captive hares were kept in an old frame residence at Ann Arbor, on dry wooden floors which we covered with a litter of straw, hay, or leaves as the case might be. The litter was changed at intervals of from one to six weeks; generally every two or three weeks, and in the meantime fresh litter was often added. The hares were, therefore, in reasonably sanitary surroundings. A few were kept in small cages, and in such cases cleaning was more frequent. The windows of the building were raised, or the panes removed, with poultry wire tacked over the openings. Outdoor temperatures were approximated.

Under these conditions all the hares thrived, except as accidents occurred, and there was at no time any evidence of sickness, nor were they ever bothered with any kind of ticks, probably because they were received in the colder months and because after being received they had no opportunity to acquire these parasites. Even fleas appeared to be scarce.

In 1928, however, we shipped our hares to northeastern Wisconsin (Fish Creek, Door County) and provided them with elaborately constructed out-of-door pens located in inhabited snowshoe hare territory where it seemed the animals would have every natural comfort. The hares arrived, apparently in excellent condition, in June. Within the month we had lost all but one of the hares, and that one was soon destroyed by a stray cat that succeeded in tearing away a part of the roof of one cage. The first hare (number 12), died on June 12; Number 15 died on June 21; Numbers 8 and 13 succumbed on June 23; and Number 11, our first captive-born hare, died on July 4, aged a year and two days. The hare that was finally taken by the cat survived until early in August.

When the first hare died it was noticed that all the captives were harassed by great clouds of mosquitoes which gathered about their heads. Thinking that there might be some connection between the death of the hare and the clouds of mosquitoes, we removed the remaining hares to a screened porch for several days. Later the mosquito nuisance appeared to have abated and the hares were returned to their pens, with results as noted.

Unfortunately the press of other affairs, distance, and warm weather combined to make the examination of these hares by specialists impossible. One hare that we skinned and examined showed no obvious lesions or abnormalities. No ticks were recovered, but it should be stated that they may have been present before our examination as the hares were, in each case, cold when found dead, and ticks are said to leave their hosts as soon as the body heat is dissipated. In the case of several hares, decomposition had advanced too far to permit adequate post-mortem examinations. The cause of these animals' deaths is unknown. It would not seem that the mosquitoes themselves could have caused this mortality. We are inclined to believe that, while there may be some connection, the swarms



UPPER AND MIDDLE: TWO POSES OF ADULT SNOWSHOE HARES
LOWER: SNOWSHOE HARE ABOUT TWO DAYS OLD (Courtesy Miss Crystal Thompson)

of mosquitoes were merely coincident to something less obvious. It is to be recalled that in 1928 wild snowshoe hares in Door County were very low in numbers.

ENEMIES

The list of animals that make the snowshoe hare almost a staple part of their diet is no doubt large and includes the great horned owl (*Bubo virginianus*) the coyote (*Canis latrans*), the lynx (*Lynx canadensis*), the wildcat (*Lynx rufus*), and at times other species.

We have seen evidence that bald eagles (*Haliaeetus leucocephalus*) prey upon snowshoe hares, and we once flushed a red-tailed hawk (*Buteo borealis*), from a full-grown hare that had just been killed.—*U. S. Biological Survey.*

MAMMALS OF THE ATHABASKA AND GREAT SLAVE LAKES REGION

By Francis Harper

[Plates 3–5]

In 1914 it was my good fortune to accompany, as zoölogist, an expedition sent by the Geological Survey of Canada to Great Slave Lake. The principal work of the expedition was the exploration of the Tazin and Taltson Rivers. These two rivers, as a single system, drain the greater part of the vast area that lies east of Slave River, between Athabaska and Great Slave Lakes, and discharge into the latter lake. This area had been traversed during the winter of 1771–72 by the intrepid Samuel Hearne (1795), but up to the time of our trip it seems to have been visited by no other white man who left an account of his travels. Consequently practically all of its geographical features remained to be mapped, and its biota was virtually unknown except by inference.

Our party consisted of eight men: Charles Camsell, leader and geologist; A. J. C. Nettell, geological assistant; Stephen L. MacMillan, Joe Nolan, John Soulier, and George Greensky, canoemen; Baptiste Forcier, interpreter; and the writer. MacMillan (since deceased) was a Prince Edward Islander; the other three canoemen were Ojibways from the vicinity of Sault Ste. Marie; and Forcier was a native residing at Chipewyan.

Our itinerary, in brief, was as follows: May 18 to June 2, Athabaska River from Athabaska Landing to Lake Athabaska; June 3 to 30, Lake

Athabaska; July 1 to 6, Lake Athabaska to Tazin Lake; July 7 to 29, Tazin Lake to junction of Tazin and Taltson Rivers; July 30 to August 15, latter point to mouth of Taltson River; August 16 to 25, Taltson River to Resolution; August 26 to September 6, Resolution to Fort Smith; September 7 to 12, trip into Wood Buffalo range, 35 miles southward from Fort Smith; September 13 to 23, Fort Smith to McMurray; September 24 to October 10, McMurray to Athabaska Landing. We traveled chiefly in scows on the Athabaska River and Lake Athabaska, and in canoes from Lake Athabaska to Great Slave Lake and up the Slave River to Fort Smith. Most of the localities mentioned in the following pages may be found on a map accompanying Camsell's report (1916) on the geology and geography of the region explored; also on a map included in one of my papers (1931, p. 22).

For various reasons the biological results of the expedition, though prepared years ago, have met with long delay in publication. Aside from a brief general account,[1] there have appeared papers on some of the fishes,[2] the physiographic and faunal areas (1931), the amphibians and reptiles,[3] and the plants.[4] A manuscript on the birds comprises the greater part of the material still awaiting publication.

The biological field work was planned under the direction of P. A. Taverner, of the Biological Division of the Geological Survey (now become the National Museum of Canada), to whom I am indebted for many courtesies. Dr. R. M. Anderson, of the same institution, has likewise been helpful, especially in arranging for the publication of two parts of the report in *The Canadian Field-Naturalist*. Edward A. Preble, of the U. S. Biological Survey, whose knowledge of the fauna of the Mackenzie Basin is unsurpassed, has kindly read and criticized the manuscript of my entire report.

One of the most interesting features of my season's work was the journey into the haunts of the Wood Buffalo. This was made possible by the courtesy of A. J. Bell, then the government agent at Fort Smith, who sent with me Peter McCallum, the veteran buffalo guardian, and Robert S. Salmon, who was then the government instructor in agriculture in the Fort Smith district and who later lost his life in the World War. Both men gave fine assistance on the six-day trip.

Jack Stark, a well-known man of the North, whom I met at Resolu-

[1] Summary Rept. Geol. Surv. [Canada] for the year 1914, pp. 159–163.
[2] Bull. Am. Mus. Nat. Hist., vol. 41, pp. 263–270. 1919.
[3] Canadian Field-Naturalist, vol. 45, pp. 68–70. 1931.
[4] Canadian Field-Naturalist, vol. 45, pp. 97–107. 1931.

tion, gave me the benefit of some very interesting observations he had made during the previous winter in the vicinity of Artillery Lake.

Preble's monumental work (1908) on the fauna of the Athabaska-Mackenzie region embodies the information on the mammals that was available up to nearly that time. The results of his 1907 trip with Seton to the region about Lake Aylmer were published somewhat later (Allen, 1910; Seton, 1911, pp. 339–358) and increased our knowledge considerably. Blanchet has done some notable exploration both north and south of Great Slave Lake, and has included in his accounts (1924–25; 1926a; 1926b; 1927) some notes on the larger mammals. Critchell-Bullock (1930–31) has also contributed some very valuable information, especially on the larger mammals of the Barren Grounds northeast of Great Slave Lake. In 1920 J. Alden Loring, Hamilton M. Laing, and I, working under the auspices of the U. S. Biological Survey and Dr. John C. Phillips, collected 368 mammal specimens, representing 21 species, in the Athabaska Basin; this collection as a whole has not been critically studied or reported on. I have recently discussed (1931) certain features of mammalian distribution in the Athabaska and Great Slave Lakes region, with particular reference to the Tazin Highlands faunal area.

During our 1914 trip the exigencies of travel along the Athabaska and Slave Rivers were such that very little collecting of mammals could be undertaken. In the rugged and sparsely timbered Tazin Highlands most species of mammals are apparently less common than in the lower and better wooded territory adjacent to it on the south and west; and trapping for the smaller species in this region was attended with very indifferent success. Very likely 1914 was one of the 'off years' for mammals in certain districts. It is interesting to compare Seton's statement (1911, p. 107) of conditions in 1907: 'During a week spent at Fort Smith, Preble had out a line of 50 mouse-traps every night and caught only one Shrew and one Meadowmouse in the week. Four years before he had trapped on exactly the same ground, catching 30 or 40 Meadowmice every night.'

Of late years, the changes taking place so rapidly in the outside world have made themselves felt to some extent in the Athabaska-Mackenzie region. In 1914 it was remote, accessible with difficulty, and comparatively little-known; visitors were something of a rarity; and romance still lingered in the offing. Nowadays a railroad extends beyond the fierce rapids of the Athabaska and connects near McMurray with steamboats plying on the northern rivers; couriers of the air cover in

an hour or two the same territory over which we toiled for weeks with paddle and portage-strap; and radio brings the news somewhat more quickly than the old-time winter deliveries of mail by dog-team. Moreover, the blank spaces on the maps of those days are now sprinkled with black dots indicating the sites of trading posts.

The photographs illustrating this paper have been reproduced by courtesy of the Geological Survey of Canada.

LIST OF SPECIES

Euarctos americanus americanus (Pallas).—Black Bear. On May 21 I saw the fresh skin of a black bear stretched on a frame of sticks at a hunter's camp on the Athabaska below Swift Current Rapid. It measured 56 inches in length, and 59.5 inches in width between the tips of the forelegs. In a log pen near by were two live cubs, of about 30 pounds' weight each. The native steersman of our scow kept a keen lookout for the animals between Grand Rapids and McMurray, this part of the river being good bear country.

Between Soulier Lake and the junction of the Tazin and Taltson Rivers signs of black bears were seen in a number of places in late July. They had been feeding largely upon the fruit (mixed with leaves) of the bearberry (*Arctostaphylos uva-ursi*). On August 5 two members of our party saw one of the animals beside the Taltson River below Twin Gorges. On August 11, below the mouth of Tethul River, the low vegetation in the woods was observed to have been trampled down considerably by some large animals. My Ojibway canoeman took up the trail and reported that it was made by an old bear and a couple of cubs.

Jack Stark informed me that a black bear had stolen some caribou meat at his winter quarters of 1913–14 near Artillery Lake, and that he had seen the tracks of one or two others thereabouts.

In ascending the Slave River to Fort Smith, I noted tracks quite commonly on the muddy shores. One animal's tracks measured: front paw, $5\frac{3}{4}$ inches wide by $4\frac{1}{2}$ inches long; hind paw, $5\frac{1}{2}$ inches wide by 8 inches long (Plate 4, fig. 2). Another's measured: front paw, $5\frac{1}{8}$ by $5\frac{1}{4}$; hind paw, $4\frac{3}{4}$ by $8\frac{3}{4}$. A third set of tracks was as follows: front paw, $4\frac{1}{4}$ by $5\frac{1}{8}$; hind paw, $4\frac{1}{2}$ by $8\frac{1}{4}$. On the river bank above Pointe Brûlée some hunter had set up on a pole a large bear's head. The skin and flesh had been removed from the face, and the bleached bones beneath, more or less surrounded by fur on other parts of the head, gave to the whole a curious appearance. This may indicate a custom on the part of the natives here similar to that practiced in the vicinity of Lake Mistassini, Quebec, where, as Low (1890, p. 25) states, bear 'skulls are always scraped clean, and set up on poles facing the sun.'

Tracks were seen in early September along a tributary of Salt River. In the wood buffalo country I saw claw marks on a number of trees; they seemed to be chiefly on 'blazed' jack pines, as if the animals were attracted to trees with man-made marks on them. Here we also saw a small piece of hide hung up in a young poplar at a native hunter's camping-place, where a drying-stage showed that an animal had been killed.

On September 26 the steersman of a scow floating down the Athabaska caught

sight of a bear on the steep side of the valley just below Middle Rapid. While preparing to fire at it, he failed to notice in time a large rock in midstream, into which the scow crashed, breaking its side. Fearing to push their vessel off in that condition, and lacking a small boat for use in getting ashore, the occupants of the scow were marooned for 24 hours until our party arrived on the scene and rescued them. As we continued our ascent of the river, I noted a number of bear tracks between Brûle Rapid and Grand Rapids.

Ursus sp.—Grizzly Bear. Occasional reports of grizzly bears in the Athabaska region may be worth recording, though they lack verification. E. B. Dennis, a trapper, told me of three grizzlies that had been killed a dozen miles below Athabaska Landing by an Indian who crawled into their den to shoot them. The hunter had not dared to seek the beasts in the open, but had waited until they had retired to their den for the winter and become somewhat torpid. Dennis also stated that a very large grizzly had been seen near House River for three years past. The name Grizzly River, which appears on the map about 50 miles southeast of McMurray, may be not without significance.

Ursus richardsoni Swainson.—Barren Ground Bear. According to Jack Stark, an Indian was said to have traded at Rae the skin of a 'white bear' that he had managed to kill, though suffering considerable damage to himself in the encounter, during the winter of 1913–14 in the general region of Artillery Lake. This is the name by which the Barren Ground bear seems to be known to the Indians of those parts (cf. Blanchet, 1925, p. 34).

Mustela cicognanii richardsonii Bonaparte.—Richardson's Weasel. At Fort Smith I obtained a trapper's skin of this weasel. It was in the white pelage, and had been taken during the previous fall.

Mustela vison lacustris (Preble).—Preble's Mink. On June 9, while pushing a canoe down a little stream on the Athabaska Delta, about 9 miles above the river's mouth, I noticed a mink standing on a root at the foot of the bank, and shot it. Having collected a female muskrat there a few minutes previously, and suspecting that the mink had been seeking prey of this sort, I examined its stomach and found therein the remains of what appeared to be two very small muskrats, perhaps 3 or 4 inches long. The specimen (a male) measured: length, 603 mm.; tail, 200; hind foot, 71.

On July 13 a mink was seen near the bank of the Tazin River, about 10 miles below Thainka Lake. It was pursued into a bit of muskeg beside the river, where it dodged among the moss and bushes. When a stick was thrust at it, the mink apparently dove into the moss and made its way beneath the surface of the vegetation for perhaps 10 feet. It next showed itself swimming in the shallow edge of the river, where it was shot. This specimen (a female) measured: length, 550 mm.; tail, 181; hind foot, 65.

Tracks, apparently of this species, were seen on July 24 along the Tazin River below Kolethe Rapids, and in late September along the Athabaska for a considerable distance below Grand Rapids.

Gulo luscus (Linnaeus).—Hudson Bay Wolverene. One day, while spending the winter of 1913–14 near Artillery Lake, Jack Stark came to an Indian shack, outside of which no tracks were to be seen, but growls or grunts issued from the inside when he tried the door. Presently a huge wolverene came out of the top of the shack, and Stark shot it. He found the place full of caribou meat,

on which the animal had been feeding for an evidently considerable length of time. A fur-trader at Resolution stated that the skin was about the largest of the species he had ever seen.

G. G. Gibbins told me of seeing two wolverenes on the northern arm of Great Slave Lake in August, 1914. One of them was discovered in a shack. During our journey through the wood buffalo range McCallum pointed out a dog-sled on the ground beneath a platform cache. He stated that he had seen the sled on the platform some time previously, and that meanwhile a wolverene had thrown it down and chewed off the babiche (rawhide). E. B. Dennis spoke of this species as common in the vicinity of Chipewyan.

Lutra canadensis canadensis (Schreber).—Canadian Otter. On August 1 our canoes were making for the shore of a little cove at the top of Napie Falls on the Taltson River, when three large otters appeared on the wooded bank. Two turned back, but the third plunged into the water. Rearing its broad head about a foot above the surface to make a brief survey, and apparently considering its escape by water cut off, it took to the land again. As it paused for a final backward glance before disappearing over the top of the bank, it looked very large, giving the impression of being between 4 and 5 feet in total length. A few moments later I caught sight of three otters, presumably the same ones, on a point of rock beside the foamy torrent below the falls. Just then a canoeman's rifle rang out, and the animals vanished. Otter sign was noticed in several places along the river in this vicinity, and again two days later near the Three Portages.

Mephitis hudsonica Richardson.—Northern Plains Skunk. On May 30 one of our canoemen saw a skunk along the Athabaska about 15 miles below McMurray. On September 6 I detected the presence of the species at Fort Smith, and was informed by Robert S. Salmon of its common occurrence in that vicinity and along Salt River.

A week later, while riding along the Smith Portage through an open growth of jack pines, I found a skunk abroad in the middle of a dark and cloudy afternoon. With camera in hand, and aided by two natives, I started in pursuit. Though headed off several times, it kept going for a hundred yards or more before it made a final stand beside some surveyors' excavations. Facing whichever one of us came nearest, every now and then it lurched forward, immediately backing off with its head low and its forefeet scratching and stamping the ground. Meanwhile it kept its tail arched and spread widely over its back. Though approached within about 8 feet, it did not bring into action its natural means of defense. It did, however, manifest a threat by means of the protruded anus. (Plate 3, fig. 3.)

On October 5 I saw the fresh carcass of a skunk at the Pelican Portage on the Athabaska, and I heard of another one taken there a few days earlier.

Vulpes alascensis abietorum Merriam.—British Columbia Red Fox. On May 27 I saw a dead red fox at the Cascade Rapid on the Athabaska; it was said by some of the rivermen to have been poisoned the previous winter. At Chipewyan I saw skeletons, said to be foxes', on the roofs of one or two cabins. This was in accordance with what seems to be a general native custom of hanging up some part of an animal as a trophy or fetish at a camp or habitation.

Tracks, apparently of foxes, were seen on the shores of Hill Island Lake and Tsu Lake. On July 25 I came upon a fox den, with several openings, in some

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spruce and pine woods near the Tazin River below Nolan Falls. Strewn about were some birds' wings and plenty of snowshoe rabbits' paws, but none were of recent capture. Our interpreter reported seeing a cross fox near the junction of the Tazin and Taltson Rivers.

During the evening of August 12, while we were encamped on the lower Taltson River above Frog Island, a fox began to bark in the forest on the opposite side of the river, whither the smoke of our camp-fire was drifting. It was a sort of coughing bark, even suggesting a catlike spitting—*quough; quough; quough*, etc. It continued for a period of 35 minutes at intervals of usually only a few seconds' duration.

Late in the afternoon of August 30, while paddling across the Slave River just below Pointe Ennuyeuse, we noticed a red fox moving in our direction along a mud-flat. It did not advance steadily, but, with head and tail lowered, nosed about in an irregular course. When we were within 300 or 400 yards, it finally took some notice of us, but after gazing intently for a few moments, apparently proceeded to disregard us. At about that time, however, it began moving in the opposite direction, hunting as it went. As we paddled on, it eventually retreated into the brush on the river bank. On the morning of September 1 we noticed tracks, apparently made the preceding night, leading right up to our tent, which was pitched on a sandy shore below Pointe Brûlée. Other members of the party reported seeing a black fox and a red fox during their journey up the Slave River a few days later.

During the trip into the wood buffalo range I noticed a set of fox burrows dug into an escarpment of very soft rock along a tributary of Salt River. The sloping bank beneath was thickly strewn with the bones of snowshoe rabbits. We also saw a dead young cross fox beside the trail.

On September 20, during our ascent of the Athabaska, we saw a black fox, with a white-tipped tail, moving along the shore of a willow-grown island several miles above Sled Island. Before daybreak on September 28 I heard a fox barking on a hill rising from the river near Middle Rapid. Several other members of the party reported seeing a fox between House River and Grand Rapids on October 1.

With the recent spread of interest in fox-farming, residents of the Northwest had begun to undertake this industry. I heard of fox farms at Athabaska Landing and Calling River, and saw several animals, including a black individual, in captivity at Fort Smith.

Alopex lagopus innuitus (Merriam).—Continental Arctic Fox. E. B. Dennis trapped a white fox, doubtless of this species, south of Jackfish Lake, near the Athabaska Delta, about January 1, 1914. He told me of two others that were taken in the vicinity of Chipewyan during the same winter.

Canis latrans Say.—Northern Coyote. According to the testimony of two residents of Calling River, the coyote is very common thereabouts. James Daniell spoke of it as fairly common in the vicinity of Chipewyan.

On September 8, as I was walking along the bank of Salt River, a coyote broke from the cover of grass near the water's edge. Very likely it had been stalking two shore birds (apparently western solitary sandpipers) which flushed at that moment in front of it. After running rather leisurely along the rocky shore for some 50 yards, it sprang to the top of the bank, but seeing me close upon it, dropped down again and retraced its course along the shore. Then going up over

the bank, it ran briskly across the grassy open and disappeared into some brush. Peter McCallum reported the coyote as common in that region.

William Brown, of Fort Smith, known for his prowess as a runner and fast dog-driver, told me of running down on snowshoes such game as moose and both species of caribou, and of overtaking a wolf in 3 miles, but the coyote, he said, was one animal that could outdistance him.

On October 13, while walking through a small wooded area on the north side of the steep Saskatchewan Valley, immediately adjacent to the main business district of Edmonton, I noticed a coyote standing among some bushes on a little ridge, where it furtively watched my approach. After several uneasy shiftings of position and attitude, it finally went off at a slow trot when I was about 40 feet distant. However, the coyote apparently felt it unsafe to leave the confines of this small woodland retreat during the daylight hours. In a few minutes I heard the crunching of leaves again, and ran in the direction of the sound. The animal evidently heard me but did not exactly locate me. It soon came to a stand where it had a plain view of me, but seemed unable to distinguish me very well except by my movements. It also seemed comparatively unmindful of sudden noises in the city at the top of the slope, as if it had become accustomed to them. Presently it trotted off and disappeared over a little rise of ground.

Canis occidentalis Richardson.—Northern Gray Wolf; Northern Timber Wolf. A man at Calling River stated that a few wolves had been taken there during the previous winter. I saw three or four carcasses in late June in a pen at a trapper's camp at the mouth of Charlot River; the animals were said to have been poisoned the previous winter. Some tracks noted along a sandy bluff at Thainka Lake on July 11 appeared to be fresh. On July 24 large tracks were found on a sandy beach on the Tazin River below Kolethe Rapids. On August 3, while traveling down the Taltson River below Napie Falls, several members of the party saw a large whitish wolf standing on the shore. At the report of a rifle it made off into the brush.

A wolf was reported to have been found and killed in the Hudson's Bay Company's stable at Fort Smith during the summer of 1914, and during the preceding winter two were killed along the river front at that post. On September 13, William Brown told me of a wolf whose tracks he had noticed for some time on the river shore opposite Fort Smith; that very morning he had observed where it had picked up a coney (*Stenodus mackenzii*) or two fallen from a fish stage. In the Hudson's Bay Company's warehouse at McMurray I saw a black wolf skin, which was said to have been taken about 100 miles west of that post.

The depredations of wolves on the wood buffaloes are touched upon in the account of the latter species (p. 34).

Lynx canadensis canadensis Kerr.—Canada Lynx. A lynx was said to have been killed by dogs along the river below McMurray on May 27. On July 4 one was seen by Mr. Camsell on a rocky promontory at Tsalwor Lake. Tracks were reported by Peter McCallum along a tributary of Salt River on September 8.

Marmota monax canadensis (Erxleben). Canadian Woodchuck. On May 28 I collected a male woodchuck at the edge of a high bank on the poplar-covered island at McMurray. MacMillan saw another woodchuck on this island two days later, and Elzear Robillard reported the species fairly common in the vicinity.

On June 1, while paddling down the Athabaska about 25 miles below Poplar

Point, MacMillan and I espied a small animal far out in the open on a broad, sandy point. Rushing the canoe ashore, we ran to head the creature off from the woods. When we were still a long way off, it flattened itself out on the sand, with its head resting between its forelegs, and 'froze' there. While one of us remained on guard and the other went back for the camera, the woodchuck (for such the animal was) did not move. Edging up on hands and knees, I began taking a series of pictures at a distance of about 25 feet. (Plate 5.) When I had covered more than half the remaining distance, it raised itself up by slow degrees, and finally started to skulk off. By this time, however, it was surrounded by a crowd, and it was made captive for a short period. When eventually released at the edge of the river, it took to the water at first and swam a little; then it scampered over the sandy shore for a few yards, and was squatting there in the open as we took our departure.

On September 8 I noticed the dried carcass of a woodchuck on an old fish stage beside Salt River south of Fort Smith. My companions, McCallum and Salmon, said the animal was common along Salt River.

Eutamias minimus borealis (Allen).—Liard River Chipmunk. On May 21 I first met with this dainty little chipmunk in a brûlée beside the Athabaska, several miles below Swift Current Rapid. While stopping to look at me from a distance of a rod, it switched its tail from side to side; but on the run it carried the tail erect. Presently I saw it going through the underbrush and along logs with some downy material sticking out of its mouth and apparently filling its cheek-pouches. A female, with two 12-mm. embryos, was taken on May 23 just above Grand Rapids. Another chipmunk was seen on May 27 above Little Cascade Rapid.

The species was not found along our route from Lake Athabaska to Great Slave Lake; in fact, it does not seem to have been recorded anywhere on the east side of Slave River (Preble, 1908, p. 167). I next saw it at Resolution on August 25 and 26. In ascending the Athabaska, I noted individuals near the Boiler and the Brûlé Rapids, and at the Pelican Portage. On October 14 two others were seen along the Saskatchewan just below Edmonton. One of them climbed up the bases of several large balsam poplars, once as high as 4 feet. I heard it give two notes—a low cluck, and a shrill, abrupt *psst*, suggesting the call of Gambel's sparrow. The former seemed to denote interest or mild inquiry; the latter, excitement.

Sciurus hudsonicus hudsonicus Erxleben.—Hudson Bay Red Squirrel. The red squirrel was the most commonly noted of all the mammals of the region. Along the Athabaska Valley its chattering and snickering were familiar sounds, and piles of spruce cone fragments, littering the forest floor in numerous places, bore witness to its arboreal repasts. Here and there among these piles were seen the openings of the squirrel's intercommunicating underground burrows. On the lower Athabaska Delta, in the absence of conifers, the species was not found.

While we were on our traverse from Lake Athabaska to Great Slave Lake, seldom a day passed when the red squirrel did not make its presence known. It was recorded at the mouth of Charlot River, Hill Island Lake, Tsu Lake, the mouth of the Taltson River, and many intermediate points. It appeared especially numerous in groves of jack pine. In such a place on the Tazin River below Tazin Lake, I enjoyed the opportunity of photographing a squirrel which, doubtless through lack of previous experience with human beings, was extraordinarily

tame. As it grubbed in the ground for things to eat, it seemed almost indifferent to my presence within a yard. When at length I wished it to pose on a tree trunk, I was able only once or twice to induce it to climb a little way up, though I followed it through the woods for several hundred yards. At Soulier Lake I found a nest in a small jack pine; its lining seemed to be composed entirely of very fine shreds of a tree's inner bark. A male was taken here, and a female at the junction of the Tazin and Taltson Rivers.

The species was recorded very commonly along the Slave River, between its mouth and Fort Smith, and likewise in the wood buffalo range.

Castor canadensis canadensis Kuhl.—Canadian Beaver. At midday on May 26 we overtook and collected a male beaver swimming in the Athabaska several miles below the Brûlé Rapid. It had probably come from one of the tributary streams, since its presence on the main river at this point seemed unusual. Its measurements were: length, 930 mm.; paddle, 260; hind foot, 165. Elzear Robillard spoke of the abundance of beavers in the vicinity of McMurray. I saw a lodge of considerable size at a muskeg pond near the river, 10 miles below this post.

At Chipewyan it was said that some of the natives were becoming restive under the law prohibiting the kiliing of beavers in Alberta. The animals were stated to have shown a marked increase under the protection of this law.

At Soulier Lake I saw a young aspen poplar that had been recently cut down by beavers. I also noticed two skulls in the Tazin River at an old camping-place at the mouth of Klo Creek; the animals had doubtless been eaten by natives.

Peromyscus maniculatus borealis Mearns.—Boreal White-footed Mouse. This species was found at the following localities: Calling River; Grand Rapids; Chipewyan; mouth of Charlot River; Soulier Lake; Tsu Lake; lower Taltson River; Slave River delta; and Resolution. On the island at Grand Rapids it was plentiful, invading our tent on two successive nights. At Chipewyan several that had been captured in dwellings were brought to me.

Along the route of our traverse northward from Lake Athabaska this species and others of its family were, for the most part, surprisingly scarce or difficult to catch, the line of traps frequently yielding nothing night after night. However, on a small spruce-covered island in Tsu Lake, where we camped for several days, white-footed mice were particularly numerous, filling the traps and rustling about the tent at night; one was discovered drowned in a can of water, and another was taken from the stomach of a doré (*Stizostedion vitreum*) caught in a net near the shore of the island. One of the Indians in an encampment on the lower Taltson River spoke of mice with long tails (doubtless *Peromyscus*) coming into their tepees.

Clethrionomys gapperi athabascae (Preble).—Athabaska Red-backed Mouse. On July 19 a dead red-backed mouse was found half-buried in the sand on a wooded point at Soulier Lake. On July 27 a female with seven 20-mm. embryos was taken in black spruce woods on the Tazin River below Nolan Falls.

Ondatra zibethica spatulata (Osgood).—Northwestern Muskrat. On the Athabaska Delta in early June I saw a number of muskrats in a little stream tributary to the main branch. A male and a female were collected here. On August 17 Mr. Camsell saw a muskrat near the mouth of the Taltson River. Tracks were seen on the lower Slave River in late August.

Zapus hudsonius hudsonius (Zimmermann).—Northern Meadow Jumping Mouse. On September 10 I saw a jumping mouse, doubtless of this species, making leaps of 2 or 3 feet at the edge of a slough in the wood buffalo range, about 30 miles south of Fort Smith.

Lepus arcticus canus Preble.—Keewatin Arctic Hare. Jack Stark reported 'plenty of arctic hares' at his winter quarters of 1913-14 near Artillery Lake.

Lepus americanus americanus Erxleben.—Hudson Bay Varying Hare; Snowshoe Rabbit. During 1914 varying hares appeared abundant in some parts of the region, and moderately common or scarce in other parts.

The first one was seen at Dunrobin, Alberta. At Athabaska Landing the white fur of the previous winter's catch was scattered all about. Bark gnawings were noted, and droppings were excessively abundant. (It may be remarked here that the latter are the most frequently noticed objects of mammalogical interest throughout the region.) During the first few days of our descent of the Athabaska between the Landing and House River, these rabbits seemed to be present wherever we went ashore, and they were not shy. Along the lower Athabaska there was no such abundance of rabbits as farther up the river, though here, as everywhere throughout the region, their well-worn trails marked the lichen-covered ground. Willows bordering the river on the Athabaska Delta had been gnawed off so uniformly (though at several different heights—perhaps the work of successive years) as to suggest a pruned hedge in appearance.

At the mouth of Charlot River a fallen aspen poplar had been well stripped of its bark by rabbits; and in several places along our route northward from Lake Athabaska their ravages on the tops of jack pine saplings were observed. A specimen was taken on July 5 on an island in Tsalwor Lake. Several rabbits were seen along the Tazin River between Tazin Lake and Hill Island Lake. At Soulier Lake, on July 21, we came upon a half-grown individual, which I was able to photograph at close range. Exceedingly few rabbits were noted between this point and Great Slave Lake. An Indian in a Dogrib encampment on the lower Taltson River told me there were none in the vicinity. Asked how he knew that, he said, 'When I go out in the woods and call them, not one comes'; and to illustrate, he 'squeaked' much as an ornithologist does to attract birds (cf. Preble, 1908, p. 200). I saw a rabbit, however, along the river a few miles below this point.

Several were seen in a spruce swamp in the wood buffalo range on September 10. A few others were noted during our return journey up the Athabaska between Long Rapid and Pelican Portage.

Odocoileus hemionus hemionus (Rafinesque).—Mule Deer. An antlered skull of this deer was noticed on May 21 at a hunter's camp on the Athabaska several miles below Swift Current Rapid. John MacDonald and Elzear Robillard spoke of the presence of the species in the vicinity of McMurray. On September 29 and 30 I observed tracks, approximately 3 inches in length, along the bank of the Athabaska in the vicinity of the Brûlé Rapid and Pointe La Biche.

The species is generally spoken of as 'jumping deer' in the Athabaska region.

Alces americana americana (Clinton).—Eastern Moose. Moose seemed much commoner along the Athabaska than in any other part of the region traversed during the season. In May signs were numerous and noted almost daily along the river between Athabaska Landing and the Cascade Rapid, and one of the animals was seen by members of the expedition near the mouth of La Biche River.

At House River a fresh skin was stretched on a frame near one of the cabins. In early June fresh tracks were in evidence on the Athabaska Delta, and MacMillan saw a moose there, about 9 miles from the mouth of the main branch. E. B. Dennis told me of a moose with three antlers that had been killed by an Indian near Chipewyan; the latter, he said, would not part with the head.

Along the greater part of our route from Lake Athabaska northward the species was evidently not common, the country being too rugged to be well suited to its needs. Signs, none of them very fresh, were noted at a number of places, including Tazin, Thainka, and Hill Island Lakes. On the evening of July 18 two of our canoemen, while hunting on the Tazin River near Soulier Lake, shot a two- or three-year-old bull. It measured (in inches): length, 89; height at shoulder, 66; tail, 5; heel to bottom of hoof, 27; width between tips of antlers (in the velvet), 28.5. Its summer coat of short fur was very black on the under side of the body and on the median line of the back; the rest of the back and sides were a sort of mouse gray. Its stomach contained about a bushel of green vegetable matter.

Fresh tracks were found near the junction of the Tazin and Taltson Rivers, and old signs near Napie Falls. On August 13, at Oracha Falls on the Taltson, we met two Dogribs who were on the trail of a moose. They had found its tracks leading to the edge of the river, and were crossing in their canoe to the other side, where they picked up the trail again. After leaving us, they very soon overtook the animal—a yearling bull—in some poplar woods, and that evening they brought us the heart of the moose as a present. These men were from a camp of about 40 people at the mouth of Pierrot Creek. Since they had left Resolution, three weeks previously, the hunters of the band had killed eight or nine moose, which, together with fish, seemed to form the major part of their fare.

I found evidence of the animal's presence at Pointe Ennuyeuse on the Slave River, along a tributary of Salt River, and in the wood buffalo range. Tracks were very common in late September along the Athabaska between Crooked Rapid and Grand Rapids, and we saw fresh moose meat in the possession of several parties traveling on the river.

Jack Stark informed me that there were no moose in the vicinity of his winter quarters of 1913–14, near Artillery Lake.

Rangifer arcticus arcticus (Richardson).—Barren Ground Caribou. About once in every ten winters, according to our interpreter, Baptiste Forcier, the Barren Ground caribou used to cross Lake Athabaska at Burntwood Island and Bustard Island; they last did so about 1911. About 40 years previously he had made a winter trip for 'meat' (i.e., caribou meat) that had been cached at a lake on the edge of the Barren Grounds northeast from Fort Smith. He had seen there 'a whole bay filled with heads of caribou looking like stones'—the Indians having killed them in the water and taken only their tongues.

The Tazin Highlands are much frequented in winter by these animals, which are doubtless attracted by the great abundance of reindeer 'moss' (*Cladonia*) in this rugged country. We found an old antler at Thainka Lake, and another at the junction of the Tazin and Taltson Rivers. At Three Portages on the latter river I found some old droppings, which Forcier pronounced those of Barren Ground caribou. According to the Dogribs whom we met on the lower Taltson River, the caribou came there about 1911, but not subsequently, 'because the timber had been burned off.' When these Indians want caribou, they go eastward

for them along Great Slave Lake. Robert Erasmus, of Stone Island, informed me that the animals come in winter to the islands in this lake.

At Resolution I secured information regarding this species from Jack Stark, who had spent the previous winter at the edge of the timber near Artillery Lake, after having been 'frozen in' on the first of September. Caribou were present till October or November, when they moved southward. There were herds of seven or eight hundred animals, and they allowed him to approach within 50 feet. The calves were 'no bigger than hounds.' The Indians (Yellowknives and Dogribs) in the vicinity speared hundreds of caribou in the water. They would make a cut across the ham to see if an animal were fat, and if not, took merely the tongue. Wolves (doubtless the Barren Ground species, *Canis tundrarum*) were numerous and, in Stark's opinion, worked more havoc among the caribou than did the Indians. In the spring the caribou returned northward about the first of May, and passed by in approximately two weeks.

Some of the Chipewyan Indians that trade chiefly at Fitzgerald spend a large part of their time in following the Barren Ground caribou in the country to the northeast, and hence this branch of the tribe is known by the name of 'Caribou-eaters.'

Rangifer caribou sylvestris (Richardson).—Richardson's Woodland Caribou. David Cardinal, a resident at Calling River on the Athabaska, stated that woodland caribou were common there—not along the main river, but far back in the woods. E. B. Dennis said there were quite a number near Chipewyan; during the previous winter a hunting party had gone out and killed half a dozen within 7 miles of the post.

On July 9 our interpreter reported some old tracks a few miles west of Tazin Lake, and on July 11 we saw other caribou tracks, scarcely more than a few days old, along a sandy bluff at Thainka Lake. It is hardly possible to ascribe these tracks to a definite species. I have no exact record of the woodland caribou anywhere on the east side of Slave River, and the presence of the Barren Ground species here at this time would probably be rather exceptional, since it moves north out of the wooded country in the spring. At the same time there is a possibility that a reindeer (*Rangifer tarandus*) could have strayed here, for about 16 of these animals had escaped from the government guardians somewhere along the Slave River not long previously. According to some of the Indians on the lower Taltson River, no woodland caribou are found there.

William Brown, of Fort Smith, spoke of securing woodland caribou every winter in the vicinity of Salt River, running them down on snowshoes; he had a number of moccasins trimmed with the white leather of this species. In the wood buffalo range McCallum pointed out a very large set of antlers on a log, saying that the animal had been killed there about three years previously.

Bison bison athabascae Rhoads.—Wood Bison; Wood Buffalo. On reaching Fort Smith in September, I was enabled, through the courtesy of A. J. Bell, the government agent, to make a journey into the haunts of the wood buffalo. A few hundred of these noble animals inhabiting the country on the west side of the Slave River were then practically the only representatives of the genus in North America living outside of a reservation, in a perfectly wild and unconfined state.

On September 7 our party, consisting of Peter McCallum (the buffalo guardian), Robert S. Salmon, and myself, set out with three saddle horses and one pack

horse. Our entire route lay in a general southerly direction. After the first couple of miles we left behind the slightly rolling country in the vicinity of the post, grown largely with jack pines, and proceeded across a fairly open muskeg for half a dozen miles. Tamarack and spruce, growing in either small clumps or extensive patches, form here a large part of the vegetation. In the more open portions of the bog appear willow, dwarf birch, shrubby cinquefoil (*Potentilla fruticosa*), and alpine bearberry (*Arctostaphylos alpina*) in abundance. Here and there the muskeg is interrupted by small areas of drier ground, grown with both aspen and balsam poplars, or by sandy ridges clothed with jack pine. The deciduous vegetation at this season presented a riot of yellow, red, and russet in strong contrast to the darker-colored conifers.

Farther on there is a gradual transition from the muskeg to a moist prairie, which is grown with grasses, bushes, and some trees, and is locally known as 'Big Prairie.' This extends for about 4 miles to the well-wooded borders of a small fresh-water stream, where we pitched camp for the night.

On the following morning we proceeded for about 2 miles along a jack pine ridge and through pleasant glades of aspen poplar to Salt River. Here, at a point perhaps 40 miles (by water) from its mouth, this stream is of insignificant size—only a rod or two in width and scarcely deep enough for continuous navigation by canoe; it is brackish in taste and contains much aquatic vegetation of slimy appearance. On the open ground beside the river some old tepee frames and drying-stages marked the site of a favorite fishing encampment of the natives. In one place limestone cliffs, 30 or 40 feet high, face the river on both sides. White spruce, aspen poplar, willow, Canadian buffalo-berry, wild rose, creeping juniper, goldenrod, aster, and grasses are some of the more conspicuous components of the vegetation here.

We forded the river at this point, and for the next half dozen miles rode up a little meandering tributary valley. The valley bottom is a boggy meadow, through which a tiny brackish stream flows. (The local name of 'sny' is applied to the stream.) The sloping banks on either side are clothed with white spruce, jack pine, aspen and balsam poplar, willow, shrubby cinquefoil, and wolfberry (*Symphoricarpos occidentalis*). Passing a small brackish lake at the head of the valley, we ascended some rising ground to a height of perhaps 100 feet, and came out upon a rolling plateau, known as Salt Mountain.

We were here within the range of the wood buffalo. While passing through a grassy glade, McCallum pointed out the first wallow—a bare, elliptical depression, about 12 by 15 feet in area, and in the middle sunk about 6 inches below the level of the surrounding ground. Within the wallow appeared some tracks approximately 6 inches in both length and width. A short distance beyond, in the woods near Black Duck Lake, some fresh dung was noted. We made camp among some spruces and poplars beside this lake, whose waters are fresh.

Immediately after setting out on September 9, we entered a locality full of sink-holes of various sizes, from 6 feet wide and deep to several hundred yards wide and 50 feet deep. These depressions are 'due to the solution of beds of gypsum which underlie the surface' (Hewitt, 1921, p. 130). According to McCallum, an old bull had been inhabiting this locality for at least two years past. Here were trails, worn 6 or more inches deep, tracks, dung, and wallows on the side of a hill. One of the wallows (figured in Hewitt, 1921, Pl. 12) had been

UPPER: BRANCHING TRAILS OF WOOD BUFFALO LEADING TO SALT LICK THROUGH WOODS OF ASPEN POPLAR. NORTHERN ALBERTA. SEPTEMBER 11, 1914

LOWER: TRACKS OF BLACK BEAR ON SHORE OF SLAVE RIVER BELOW MCCONNELL ISLAND, MACKENZIE. AUGUST 28, 1914

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pawed out for a space of about 25 feet along the slope. The bark at the base of a tree standing in it had been rubbed off by the buffaloes.

Within the next few miles we passed Last Salt Lake, the southernmost body of brackish water along our route, and presently came to some well-worn trails (Plate 4, fig. 1) leading eastward toward a salt lick. Later we crossed one or two more sets of trails converging toward the lick. One set usually consists of three or four parallel paths, from one to several yards apart, with many connecting branches. Following some fresh tracks on foot along the trails through fine woods of poplar and spruce, we came in 1½ miles to the salt lick. This is a level, irregularly shaped area, at least 100 yards long and 30 yards wide. The place was so thoroughly covered with tracks as to suggest a barnyard, and was plainly frequented by numerous animals. Here and there in the soft, damp, blackish earth appeared a whitish deposit, doubtless some mineral salt. The lick is bordered with grass, willow, and black spruce in succession. Near the middle is a bed of cat-tail (*Typha latifolia*), and on one side is a swampy pool.

During the rest of the day we followed a trail for 7 or 8 miles in a southerly direction. The trail was very evidently kept open mainly by the buffaloes; and every now and then we passed one of their elliptical wallows. In this part of the range, groves and open thickets alternate with brushy and grass-grown glades. The two species of poplar, together with willow, form the major part of the higher vegetation, though we also passed through a stand of magnificent white spruce. Both poplars attain an exceptional size here; I saw trees 75 or 80 feet high and nearly two feet in diameter. Some of the lower growth is dwarf birch, shrubby cinquefoil, serviceberry, wild rose, few-flowered viburnum, fireweed, thistle, goldenrod, and aster. Larkspur and harebell bloom beside the trail. Bearberry is practically everywhere. There are also several leguminous plants (including *Lathyrus ochroleucus* and *Hedysarum boreale*) that grow extensively here, and that deserve mention as probably an important part of the buffaloes' food.

After spending the night beside a fresh-water lake, we proceeded, on September 10, south or a little west of south and soon came to a large grassy meadow. Here half a dozen buffaloes, McCallum said, had remained during the previous winter till February, when passing dog-teams scared them away. We next passed through an extensive windfall of jack pines. Farther on McCallum pointed out the site of a 'round-up' during the rutting season of 1913. It had taken place, he said, in August. At that time the ground had been bare and much ploughed up, and now there were several wallows in evidence. Some small trees had been knocked over, and others, still standing, had had their bark worn off by the buffaloes.

We then crossed a muskeg in a valley, with a small creek flowing through it, and ascended a sandy ridge grown with jack pine and densely carpeted with bearberry. On the opposite side of the ridge, toward the northeast, is an extensive spruce swamp. This, the southernmost point of our journey, was probably close to latitude 59° 30′ N. McCallum considered this the limit of the wood buffaloes' summer range. Signs of the animals, though still common here, were not very fresh. From an elevated point on the ridge we could look south over the country stretching away toward Peace River, where the buffaloes were said to go in winter to feed on the vegetation of the sloughs.

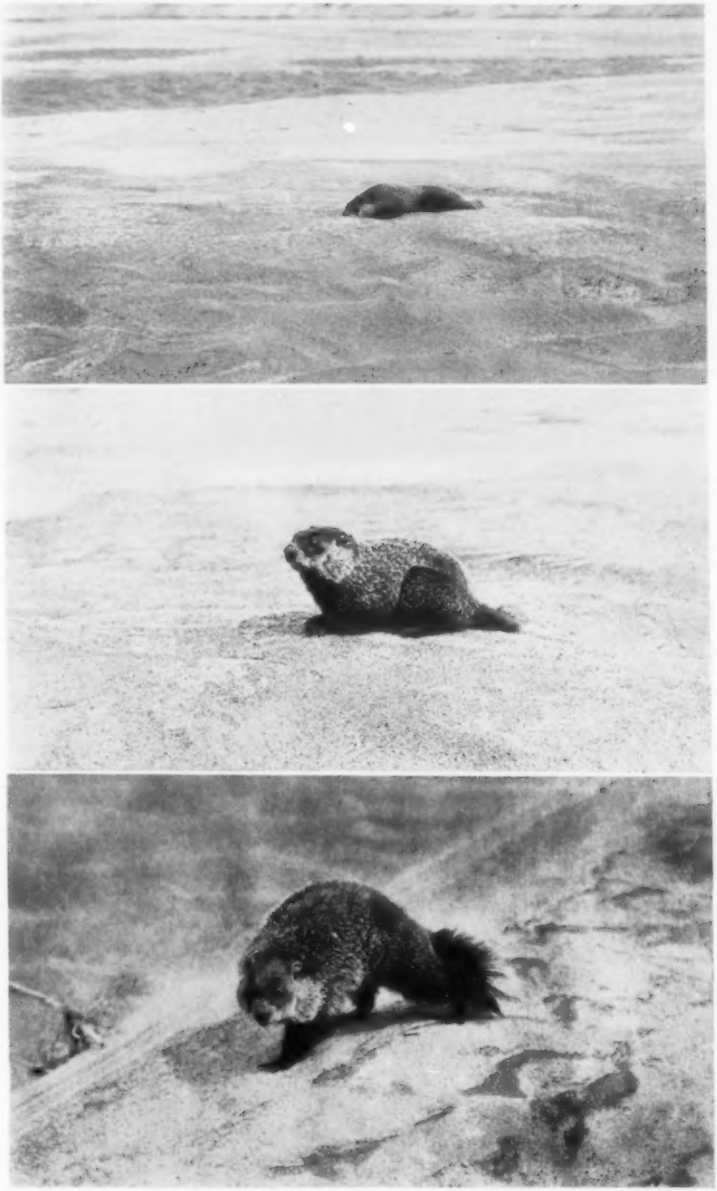
On September 11 we retraced our course as far as Last Salt Lake, and on the

following day arrived at Fort Smith. In the late afternoon on the 11th, on reaching one of the sets of trails near the salt lick, we discovered fresh tracks of two animals—one large, the other medium-sized—and immediately set out afoot to follow them toward the lick. Unfortunately the light wind was almost at our back. Our plans were also much interfered with by the rain, which kept up almost continually during our entire stay in the buffalo country. At one point the tracks left the trail, but farther on reappeared. When we had come within half a mile of the lick, there was a sudden commotion in the timber about 50 yards on one side, followed by the sound of heavy hoofs pounding away over the mossy ground. This was the larger of the two animals, as McCallum determined by the tracks. Just before coming out of the woods near the border of the salt lick, McCallum crouched down with a whisper and pointed out a buffalo in the open a hundred yards or more ahead. It was medium-sized, and appeared at the first glance almost jet-black. At that moment it was turning around broadside to us, as if to sniff about, having doubtless detected a taint in the breeze. There is no probability that it was disturbed by any sight or sound. While I was getting a camera ready, McCallum saw the buffalo lick its nostrils, and from this action he concluded that the animal had definitely winded us and was on the point of making off in alarm. I looked up just in time to see it gallop off over the boggy ground into the willows beyond. It did so, in spite of its great bulk, with an appearance of lightness and agility.

According to McCallum, the wood buffaloes were divided into two main groups. It was the southern herd whose territory we had entered, while the range of the other lies northwest of Fort Smith between Buffalo River and Little Buffalo River. Part of the northern herd was reported to have been seen within 20 miles of Great Slave Lake during the winter of 1912–13. The two ranges are separated, McCallum said, by a strip of jack pine country 20 or 30 miles wide, in which he had seen hardly a single trail. He estimated that there were about 500 animals in the two herds, the northern one being slightly the larger. There is scarcely another large animal which puts its mark so plainly upon the country it inhabits; and I could readily believe, from the abundance of signs I saw in the range of the southern herd, in the way of deep-worn trails, scores of wallows, and the tracked-over salt lick, that the above estimate was a very reasonable one. The southern herd must range over nearly a thousand square miles, and with an average of only one buffalo to two square miles, it would contain about 500 individuals.

At this period the hunters from Fort Smith and Fitzgerald regularly resorted to the wood buffalo country for game, since it is also supplied with black bear, moose, and woodland caribou. The presence of wardens was (and is) vitally necessary to guard the buffalo herds from these irresponsible natives, who were still supposed to make away with a young animal now and then. The setting aside of the wood buffalo range as a national wild-life refuge in 1922 was an urgently needed measure, in order to keep it free from possible agricultural development as well as from hunters' depredations.

Though I saw no signs of wolves, the numbers of them that inhabit the region are probably considerable, and there is no reason to believe that they do not pull down an individual buffalo now and then, especially when the snow is deep. In fact, A. J. Bell presented me with the foot of a two-year-old cow, which had been pursued and killed by four or five wolves about 70 miles northwest of Fort Smith



CANADIAN WOODCHUCK 'FREEZING', THEN ASSUMING A SQUATTING POSTURE, AND FINALLY SKULKING OFF. ATHABASKA RIVER BELOW POPLAR POINT. JUNE 1, 1914

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in March or April, 1913. It was found, when freshly killed, by G. A. Mulloy, a former buffalo guardian, and several Indians. The marks in the snow showed where the wolves had laid down to rest after gorging themselves upon their fallen prey.

John MacDonald, of McMurray, informed me that the last wood buffaloes in the region of the Athabaska River had been killed about 25 years previously. In the few years before that time he had gone after more than one load of buffalo meat. They were formerly found, he said, on Stony Mountain (about 25 miles south of McMurray) and on Thickwood Mountain, on the west side of the Athabaska, ranging as far south as Grand Rapids and as far north as Birch Mountain.

Among the principal accounts of this species are those by Preble (1908, pp. 143–150), Hewitt (1921, pp. 123–133), and Seton (1927, pp. 706–717). The one by Hewitt includes the substance of a report made by Charles Camsell after a trip to the wood buffalo range in September, 1916.

With the beginning in 1925 of the annual transportation of large numbers of plains buffaloes from the Wainwright herd in central Alberta to the Wood Buffalo Park, a new and distressing chapter in the history of the present species was introduced. This, however, is not the place for a discussion of it.

Ovibos moschatus moschatus (Zimmermann).—Musk-ox. I was informed by Jack Stark that some Indians, whose winter quarters were near Artillery Lake in 1913–14, made a six-weeks trip northward from that locality after musk-oxen, but secured none. The robes at that time were said to bring a price of $50.

According to Blanchet (1925, p. 34), the Great Slave Lake Indians no longer make these winter trips after musk-oxen.

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NEW RECORDS AND SOME OBSERVATIONS ON CONNECTICUT MAMMALS

BY GEORGE G. GOODWIN

While collecting mammals in Connecticut during the summers of 1928 and 1930, I made several new records for this State. So far as I know, prior to 1928, *Synaptomys cooperi*, *Napæozapus insignis*, *Sylvilagus mallurus*, *Sorex palustris*, *Sorex fumeus* and *Parascalops breweri* had not been recorded from here.

I found *Synaptomys cooperi* inhabiting cool wet pockets in the hills in Macedonia State Park near Kent, west-central Litchfield County, at an elevation of 1,000 feet. They seemed restricted to the shade of a thick forest growth where the floor was more or less overgrown with ferns, sphagnum and other mosses, and where the branches of the trees interlaced overhead, allowing only a very limited amount of sunlight to penetrate through to the ground.

Definite runways were not visible on the surface, though subterranean passages through the moss were not uncommon. The presence of *Synaptomys*, however, was at once indicated by cuttings of saw-grass, chopped in lengths of about one and one half inches, heaped up under the edges of large tussocks of grass. Other full length grasses were cut off at the base and dragged under cover. The small piles of cuttings were in various stages of decay. Some were quite fresh, and judging from the uniform condition of the individual piles, I should say that each was a single night's work and that here at least *Synaptomys* did not

travel back and forth much. Once having taken the cream of the crop from one tussock it apparently moved on to the next, and for the time being did not return to its previous feeding ground; but whether it spent its rest period in the particular tussock where it was feeding or had a regular den to which it resorted, I am not prepared to say.

To a certain extent *Synaptomys* seems to be active in the forest at all hours of the day. I saw one out at eleven in the morning on a bright, sunny day and two others I took in the early evening.

I found no *Microtus* or other mice in this immediate vicinity, though I trapped the section thoroughly. An old nest in the center of a tussock of saw-grass was composed of dried leaves, some moss, and a few long shanks of grass, which seemingly served the purpose of holding it together. The nest was globular, about five inches in diameter and four inches high.

My records of the red-backed mouse, *Clethrionomys gapperi*, in Litchfield County are not the first for the state; but in recent times it has never been very plentiful and is now quite rare. It is found only locally in the highlands of the northeast and northwest. I obtained four specimens, two from Sharon and two from Kent. Records other than mine were from Salisbury, Litchfield County and Woodstock, in the highlands of Windham County.

Napæozapus insignis is a new record for Connecticut. Specimens of this genus I found to be fairly plentiful along the mountain streams in Litchfield County, but sparingly distributed in the northeast and not at all in the central lowlands and coastal region.

Fresh water seems to be a necessary part of the habitat of the woodland jumping mouse for I have never trapped it far from a stream, or water of some kind, and then usually only on the gravel at the margin of swiftly running water or among the stones and drift wood out in the stream. One specimen, caught by its tail, apparently had been out all night in the wet and to all appearances was quite stiff and cold in the morning. After I held it in my warm hand for some minutes it began to show signs of life and later completely recovered. It ate almost anything offered in the way of seeds but seemed particularly fond of blackberries and sweet corn.

Some of the *Zapus hudsonius* I caught had their feet and mouths stained with the juice of blackberries. This species seems to adapt itself to all kinds of conditions. I found them on dry open hill tops half a mile or more from water and again in large flooded cranberry bogs, where they followed regular, well defined runways which extended

20 feet or more in a straight line and which crossed each other at various angles.

I found some evidence of wood rats (*Neotoma pennsylvanica*) on the high rocky ridges of Litchfield County and have one specimen from Scattercoat Mountain near Kent. I do not believe that it is common anywhere in this State.

Linsley claims that beaver (*Castor canadensis*) were apparently exterminated in Connecticut prior to 1842 but were plentiful before that time. Today there are a few beaver in Windham County, where it is said a pair was introduced some years ago.

For some reason or other the porcupine seems practically absent in this State. I have one or two reports of specimens taken in western Connecticut but nothing very definite. Porcupines are quite common in Massachusetts, just across the state line from Mashapaug. Conditions in Litchfield County, Connecticut, afford ideal cover and food for the porcupine but for some reason it is not found within the borders of the State.

A hundred years ago the fox squirrel (*Sciurus niger*) was found over most parts of Connecticut, with the possible exception of the coniferous forests in the highlands of the northeast and northwest. Today it is quite extinct in this State. Linsley records one specimen from Northford.

The varying hare (*Lepus americanus*) is fairly common in the highlands of Litchfield County and to a less extent in Windham and Hartford. The introduced European hare is very common in western Connecticut from where it is steadily spreading to the north and east.

The New England cottontail (*Sylvilagus transitionalis*) is the common rabbit of Connecticut. So far as I know, *Sylvilagus floridanus mallurus* has not previously been recorded from this State. I got two specimens from Litchfield County close to the New York border. One was shot within one hundred yards of the place where I got two *S. transitionalis*, though in different surroundings; the latter being taken on the dry wooded hillside, while *S. f. mallurus* was killed in a wet marsh. These two specimens are readily recognized as *S. f. mallurus* by the broad ante-orbital processes of the supra-orbital with a well defined notch, large rounded bullae and noticeably longer ears than in *transitionalis*.

I obtained all three species of eastern moles in Connecticut; Brewer's mole (*Parascalops breweri*) in the highlands of Litchfield County and the common garden mole (*Scalopus aquaticus*) in the central lowlands and coastal region. The range limits of these two species just about over-

lap. The third, the star-nosed mole (*Condylura cristata*), is relatively common throughout the State, with the possible exception of the immediate coastal strip. One which I put in a tub of water swam and dived with the skill of a muskrat, and remained under water for from 10 to 15 seconds. It progressed by striking out alternately with fore and hind feet, and showed a slight tendency to scull with its tail. It did not attempt to climb over the side of the tub without first trying every means to escape through the bottom. It detected sound much quicker in water than on land.

I obtained four species of shrews in Connecticut: *Blarina brevicauda*, *Sorex palustris*, *Sorex fumeus* and *Sorex cinereus*. I was not able to add *Sorex dispar* to the list, but believe that it will eventually be found in the high mountain sections of Litchfield County. Prior to 1928, *S. fumeus* and *S. palustris* had not been recorded from the State.

I found *Sorex fumeus* to be relatively common everywhere, though a specimen of *S. cinereus* was quite an unusual catch. Water shrews were comparatively plentiful in the high western area, but not in the northeast. They seemed to use more or less regular tracks along and under the banks of small, swift mountain streams. I found that they usually sprung my traps when they passed along the trail, though not attracted by the bait.

Linsley, 1842, recorded *Cryptotis parva* from Salisbury and from his description of the specimen I believe he was right in his identification.

Linsley also gives some interesting reports on the large carnivores of Connecticut, and says that three years previous to the date of his report a large wolf was killed near Bridgeport, and one ten years previous at Newton. He also reports pumas having been killed in Connecticut and says he saw one that was supposedly killed in the northern part of the State. Incidently he claimed that at that time pumas were still plentiful in St. Lawrence County, New York, and says: "One man killed 5 with his dog and gun not many years previous."

Bay lynxes (*Lynx rufus*), from all accounts, are still quite plentiful in this State and considerable numbers are reported each year by trappers. I also have one or two reports of the Canada lynx (*Lynx canadensis*) from Litchfield County but none was authentic.

During my field work I saw white-tailed deer (*Odocoileus virginianus*) in almost all parts of Connecticut. It is only recently that deer have become plentiful in this State. During the early part and the middle of the 19th century, deer were practically unheard of; and it was not until 1893, when the State Legislature passed a law for their protection,

that there were more than a few individuals here. The animals however soon began to respond to the protection offered and reports of deer in western Connecticut became more and more frequent. Today they can be found any time in almost all suitable parts of the State.

I find no definite records of other ungulates in Connecticut. The River Titicus formerly bore an Indian name (Mutichtaeus) which according to tradition signifies "Bison Creek." According to W. J. Hayes (1871), bison ranged along the east coast from the valley of the Connecticut south to Florida. There is, however, no proof that bison occurred during recent times in this State. Dr. Allen records the discovery of late Pleistocene bison from eastern Massachusetts, which indicates a former range much farther eastward of the known limits of the present day bison.

Moose, according to Thomas Morton (1637), were found in the vicinity of Plymouth, Massachusetts, which is so near the Connecticut border that it is fair to assume that at one time they ranged in the northern section of this State. General Winthrop, 1713, had a herd of moose on Fisher's Island, then in Connecticut, which he intended to present to Queen Anne. Most of the animals, however, died or were killed by poachers before he was ready to ship them.

Sherman W. Adams included caribou in his list of "Native and Wild Animals of Connecticut (1840)." There is no conclusive evidence available that caribou were ever found there. Caribou range only as far south as Grafton, Maine, and have been recorded from Connecticut Lakes, New Hampshire. It was probably the suitable food and conditions for caribou on the elevated ridges in Connecticut which led Adams to believe that they originally ranged in this State.

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NOTES ON PERSONAL EXPERIENCES WITH PRONGHORN ANTELOPE IN TEXAS

By Leo T. Murray

From 1909 to 1916 inclusive I had the good fortune to live in Mertzon, a small town of western Texas. This little town is situated about thirty miles west of San Angelo and about twenty miles east of the head waters of the streams that drain into the Colorado River of Texas. These streams all begin as slight depressions in an almost level plain or plateau covered with a thick growth of good grasses and a scattering stand of mesquite trees. Within a few miles they become broad, shallow, but well defined valleys. A short distance farther on the plateau becomes rather generally dissected and the landscape changes to one of low limestone hills characterized by the customary ledges of calcareous sedimentary formations and by scattered clumps of oaks and junipers. It is in this section of the drainage that Mertzon is located.

A short time after my family settled there, the old stage line running from San Angelo through Sherwood, Mertzon, Ozona, and Juno to Comstock on the Southern Pacific Railroad was discontinued and automobiles were put on as an experiment. A year or so later the Kansas City, Mexico, and Orient Railroad extended its line west from San Angelo, and what was left of the real West in Texas vanished almost overnight. As a part of this inevitable result, the bulk of the native wild life suffered sudden and serious depletion.

The most outstanding animal to be affected by the railroad and the automobile was the pronghorn antelope, *Antilocapra americana*. A few years prior to this time these animals had roamed in small and large herds over all the plains and upper valley regions of this part of Texas. Even at this time, though their numbers had been greatly reduced, they were common on these ranges. It is not surprising, therefore, that a boy possessed of a natural love for animals should have come into possession of a pet antelope.

It came about in this manner. A neighbor, who also liked pets, captured Minnie soon after her birth and brought her home with him when he returned from a visit to a ranch on the "divide." He placed her in his yard, which was surrounded by a high picket fence, and here she lived until she was about one year old. During this time what little natural fear of man that she had was completely lost and she became very docile and affectionate. About this time her owner decided that she was completely tamed, as indeed she was, and that it would be safe

to turn her out to graze during the day on the abundant grass that follows the spring rains. Accordingly, he liberated her one morning. During the day she investigated thoroughly the immediate neighborhood and ate so much green grass that she did not want her feed at night. All means of returning her to her pen having failed, her owner was forced to let Minnie spend her first night out. The next afternoon he decided to change his tactics. He placed the usual amount of cotton seed meal and hulls in her feed pail and placed the pail near her but some distance from the gate. Then he turned and walked back to the yard fence. The antelope finally decided to taste the food but she still suspected some trick on our part. At first she would take her head out of the pail every few seconds to reconnoiter. Each time she did this she saw us quietly talking by the fence. At last she kept her head down long enough for the neighbor, who was a very large man, to approach and seize her about the middle. He succeeded in lifting her and carrying her a few feet, but she objected so vigorously that his clothing was almost torn from his body by her sharp hoofs moving with the speed of a rip saw. He was obliged to drop her, and he was so exasperated at her that he gave her to me on the spot. I was as pleased as any ten year old boy could have been.

There being no fence about my home, Minnie soon adopted it as her own. As long as she remained in my possession no one ever tried to confine her. She soon extended her daily range to practically the entire town. At times she seemed to feel especially playful and frolicsome. On these occasions she almost always went to the main street of the small town and persuaded the stray dogs to chase her. For from half to three quarters of an hour she would run from the noisy curs with a great show of feigned fear, her superior speed and intelligence always keeping her well out of their way. She would circle and wait for them to come up to her. Then she would be off in the opposite direction with a phenomenal burst of speed. She would soon slow down and wait for them again. When she finally tired of this game of tag, she simply ran home and left the pack. No dog was ever swift enough to force her to vary her program.

Like Mary's famous lamb, Minnie often followed me to school. She soon learned that if she ran across an outdoor basket-ball court while a game was in progress, some one of the players would throw the ball at her. This pleased her greatly. Though she would fluff the hair of her white rump and dash off with all the speed of a badly frightened animal, she soon came across the court again. This became an established game between the pupils and the antelope.

But no matter what she did during the day, Minnie seldom failed to be at home at milking time. My father always gave her a small portion of the cow's food. This was placed in a depression in a large stone that happened to be near by. She would advance gingerly and very daintily sniff at the feed. Then, very leisurely, yet carefully, she would proceed to eat, never taking more than a mere nibble at a time. Better table manners could not be imagined. On one occasion a half grown calf was fed on a stone a few feet from the one on which the antelope always ate. Since both were given about the same amount of food, the calf finished hers long before the antelope. She then moved across to where Minnie was feeding; and, before I noticed her, had taken a mouthful of the feed. The antelope very indignantly moved off. I immediately drove the calf away and coaxed my pet back again, but she would have none of it. After one sniff at the remaining food she walked away with a disgusted snort, evidently highly incensed at being insulted in such a manner. At another time she was eating a cabbage leaf that my mother had given her. She placed one fore foot on the thickened central portion and was taking small pieces from along the edge of the leaf. My small brother decided to tease her by taking her cabbage leaf. She very promptly butted him over and proceeded to eat unmolested. She did not seem to attack him in anger. She merely wanted him out of the way and proceeded to accomplish the desired result in a very matter of fact manner.

She lived thus under practically natural conditions for another year. My father, thinking it probable that some harm would come to her if she continued to have the run of the town, decided to send her to an old friend of the family who was establishing a park in central Texas. He also thought to ship the antelope without my knowledge or consent, but in this particular he was unable to carry out his plans. I was at school when he, by means unknown to me, succeeded in getting her into a shipping crate. This so frightened the little animal that she was in a fair way to injure herself in her efforts to escape. No one was able to calm her. As a last resort, I was sent for. My presence seemed to be all that was needed. As long as I stood by the crate, she seemed to have no fears; but if I moved away, she showed by trembling and other signs that she was highly excited. In spite of all this, she arrived safely and lived for several years in the park. She mated, gave birth to twins, and cared for them in a perfectly normal way, I understand; though I never saw her after she was sent to the park.

In the latter part of 1916 my father removed with his family to Ozona,

Texas, a similar town in a very similar location on the opposite side of the "divide." The drainage here is part of the Pecos River system, but the surrounding country is characterized by the same geological formations, the same plant associations, and by the same groups of animals. Antelope were quite common, though not abundant on the open ranges round about. The central square of the town had been improved as a small park. In this park was a pair of antelope.

Both male and female were quite gentle and had the freedom of the entire park. Naturally, I soon made their acquaintance. The male had a habit of placing his head against a person's knee and pushing until his head was scratched between the horns. He never seemed to tire of this, especially in the season when he was growing his new horn covers. This pair also produced two young but the mother refused to care for them. The attempt to raise them by bottle feeding failed.

The comparatively small number of antelope in Texas at that time, which was only a remnant of the thousands that once grazed on its plains, has been greatly reduced within the last few years. In so far as I know, there is not an antelope on all that divide now (1930), though range conditions have seemingly been changed little or none. Altogether I know of less than forty antelope in Texas now in the wild state, and they are scattered from Marathon to El Paso, a distance of two hundred and fifty miles, the largest band being on H. L. Kokernot's ranch near Alpine. Ten years ago when I first saw this herd there were nineteen animals in it. Seven years later I again was able to count the members of it and there were still nineteen in it. On several occasions I have noted young ones with the herd, so it is evident that there is an uncalled-for mortality rate. Since the number of predatory animals of the region has been greatly reduced within recent years, I do not think that they are to be suspected. I once read an article by an old ranchman in which he advanced the theory that antelope were failing to increase because they would not feed where the grass smelled too strongly of cattle. The western ranges are more heavily stocked with domestic animals than ever they were with buffalo. My observation of my pet and the calf would seem to offer some support for his theory. On the other hand, I have never seen a poor or badly conditioned antelope on the ranges. If they failed to eat, their physical condition would certainly show it. My own opinion, based on an intimate knowledge of the people of the section, is that the antelope are being constantly killed with high powered rifles. The habits and habitat of the animals make them particularly easy marks to a person wishing to kill them. Enforcement of game

laws practically did not exist in that section until very recently. Even now I doubt that there is sufficient enforcement to save the antelope from extinction in Texas.

The pronghorn should certainly be preserved for its unique scientific significance. It is the only living species of its genus. That genus is the only living genus of a family. Fossil remains indicate that it is one of the oldest of American families. It occurs nowhere else on the globe. When the passenger pigeon and the heath hen were exterminated through man's cupidity and ignorance, they left near relatives somewhat similar in appearance. But when the last antelope is gone, there will be no similar living creature on all the face of the earth.

Cornell University, Ithaca, N. Y.

BREEDING HABITS IN CAPTIVITY OF MUS BACTRIANUS BLYTH

By C. V. Green

In September, 1926, eleven *Mus bactrianus*, six males and five females, the survivors of forty-four with which Dr. Sheo Nan Cheer started from China, arrived at Ann Arbor, Michigan, for Dr. C. C. Little. Two females and one male died within a few days, so it is from the remaining eight animals that the present strain in this laboratory is derived.

These mice were captured near Peiping and specimens from the stock have been identified by Dr. G. M. Allen as intermediate between the subspecies *gansuensis* Satunin and *tantillus* Allen (1927); on the whole, probably closer to the former. They are small, active, short-tailed animals usually attaining an adult weight about half that of the *Mus musculus* of our laboratory strains. In color they are sandy dorsally and white ventrally. (Their genetic formula is DBA^{w} . . . . etc.). There is some variation in both dorsal and ventral coloration but in nearly all the animals the belly hairs are white to the base.

When first introduced into the laboratory the Chinese mice were very wild, their behavior being in marked contrast to that of the stocks of *musculus*. Successive captive generations, however, no doubt partly through continued handling, have become much tamer.

Bactrianus males mate readily with *musculus* females as reported by Little (1927, 1927a) and the offspring of both sexes are fertile. The

reciprocal cross has also been made on several occasions, although with more difficulty. The first generation hybrids, especially while young, are very active and wild, far surpassing either parent species. Since the genetic factors of *bactrianus* determining coat color are dominant, the hybrids are intense black agoutis with white bellies; although much darker than the Chinese parent probably because of darkening modifiers brought in by the *musculus*. As *bactrianus* differs from our laboratory strains of *musculus* in qualitative as well as quantitative characters, these mice have been used by the author (1930, 1931) in genetic studies of size inheritance. It is a point of interest that probably some form of this species represents the ancestral stock from which the Japanese waltzing mouse has been derived (Gates, 1926).

Bactrianus seems to show no definite seasonal cycles in reproduction since in the heated mouse rooms, with the temperature kept at approximately 70° Fahrenheit during the winter, litters are born throughout the year. Litter size averages less than in any of our stocks of *musculus*, the mean for 180 litters being 4.4 ±.09, while for 1400 litters of an inbred strain of dilute brown non-agouti *musculus* it is 5.4 ±.04. This latter figure is rather lower than those for other strains of the same species.

Their litters not only average smaller but the *bactrianus* females bear their first litters at a considerably greater age than do the *musculus* females. This is shown in the table below. The *musculus* females belong to the inbred strain mentioned in the preceding paragraph and the mean was computed from data furnished by Dr. W. S. Murray.

	Number	*Mean age at first litter*
bactrianus females	57	177 ±6.2 days
musculus females	317	102 ±1.1 days

In all cases the female had been mated at weaning.

Females of the Chinese mouse, like the house mouse, are often in oestrum within twenty-four hours after the birth of a litter. The period of gestation likewise seems to be the same for the two species: twenty days when not lengthened by the nursing of young.

As in *Mus musculus* and the albino rat, *Rattus norvegicus*, (King, 1916), the first litter of a *bactrianus* female is usually smaller than her second or third. In regard to age, the author (1931) found that inbred *musculus* females attained maximum average litter size at about one hundred and fifty days. In *bactrianus*, as might be expected from their late maturing, this high point seems to come sixty or seventy days later. The number of litters, however, is too small to make this finding conclusive.

Some of the females continue to produce litters, although small ones, at an advanced age. One female cast a litter of two on her 530th day of life; another gave a litter of the same size on her 568th day; still another a litter of three on her 588th day; while the record in our stock is a female which bore two young when 648 days old.

Bactrianus seem to be rather long lived in comparison with most of our *musculus*. One example, a male of the second captive generation, died at the age of thirty-four months (1032 days). This patriarch sired a litter born sixty-seven days before his death. Despite his longevity he was far from the extreme age of five years and eight months which Sumner (1922) recorded for a *Peromyscus* female.

In summarizing the foregoing discussion it may be said that *Mus bactrianus* females cast smaller litters, bear their first litters later and attain maximum litter size later, than do females of a domesticated strain of *Mus musculus*, but agree with the latter in the length of the gestation period.

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Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine.

NEW DATA ON THE PALEOCENE MAMMALS OF ALBERTA, CANADA

By Loris S. Russell

Paleocene mammals were first discovered in the Province of Alberta, Canada, by Mr. Barnum Brown, of the American Museum of Natural History, who found a small fauna at one locality in the Paskapoo formation on Red Deer river. As described by the late Dr. W. D. Matthew,[1] the collection included a curious mixture of Lance and Paleocene mammals, but the former were considered to predominate, and the age of the remains was determined as Uppermost Cretaceous. Some years later the writer and his friends began the collection of fossils in the Paskapoo beds near Calgary, and eventually a few mammalian teeth were discovered. One of these was made the type of *Catopsalis calgariensis*,[2] the first Paskapoo mammal to be referred definitely to the Paleocene. This was followed shortly by Dr. G. G. Simpson's redescription[3] of the Paskapoo collection in the American Museum of Natural History. This author found that the supposed Lance aspect of the Paskapoo fauna was due to the accidental inclusion with it of specimens from the Hell Creek beds of Montana. As defined by Simpson, the Paskapoo mammals are all of Paleocene type, and pertain to the upper, or "Tiffany-Clark Fork" stage. Meanwhile, field parties of the Research Council of Alberta, to which the writer was attached, discovered additional mammalian remains in the Paskapoo beds of the Alberta foothills. The writer's preliminary identifications,[4] made without access to the type specimens, included some errors; but the age of all the material was correctly recognized as Paleocene. Somewhat later the revised determinations of all the Paskapoo vertebrates were published,[5] with the descriptions of some new species. Subsequent work on the Paskapoo and other formations of western Alberta has brought to light a few more specimens, some of which represent additions to the known Paleocene fauna of Alberta, while others give further information on the structure or relationships of previously known species. The purpose of this paper is to present these additional data. The writer is indebted to Prof. John A. Allan, of the University of Alberta, for permission to

[1] Bull. Geol. Soc. America, vol. 25, pp. 388, 389. 1914.
[2] Amer. Journ. Sci., vol. 12, p. 230, fig. 1. 1926.
[3] Amer. Mus. Nat. Hist., Novitates No. 268. 1927.
[4] Sci. Ind. Res. Coun. Alberta, Rept. No. 17, pp. 41, 42. 1927.
[5] Amer. Journ. Sci., vol. 17, pp. 162–178, figs. 1–5, 1929.

complete this study, and to Dr. G. G. Simpson, of the American Museum of Natural History, for assistance in the comparison with Paleocene mammals of the United States. The illustrations were prepared by the writer. This paper is published with the permission of the Director, Research Council of Alberta, Edmonton, Alberta, Canada.

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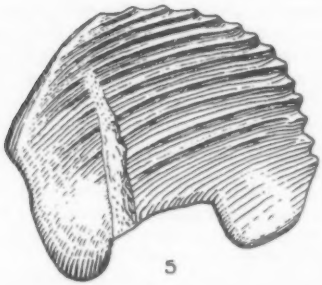

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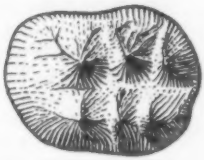

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ALBERTA PTILODONTIDAE, ×10. FIG. 1, *Ectypodus cochranensis?*, right P^4, crown view. FIG. 2, the same, external view. FIG. 3, *Ectypodus cochranensis?*, left M^1, crown view. FIG. 4, *Ectypodus cochranensis?*, left M^2, crown view. FIG. 5, *Ectypodus cochranensis*, holotype, left P_4, external view. FIG. 6, *Ptilodus?* sp., P^3, crown view.

Order **MULTITUBERCULATA** Cope

Family **PTILODONTIDAE** Simpson

Genus **Ectypodus** Matthew and Granger

Ectypodus cochranensis (Russell)

Ptilodus cochranensis Russell, Amer. Journ. Sci., vol. 17, p. 172, fig. 1. 1929.

Holotype.—No. 129, Dept. of Geol., Univ. of Alberta; left P_4 from locality 1, Cochrane, Alberta (Legal subdivision 7, section 4, township 26, range 4, west of 5th meridian). *Plesiotypes:* Nos. 337 and 338, U. of A.; from locality 11, Cochrane, Alberta (Legal subdivision 4, section 1, township 26, range 4, west of 5th

meridian). *Referred specimens:* Right P^4, left M^1, right M^2, from locality 11, Cochrane; left P^4, right M^2, fragmentary P_4 from locality 2E, Calgary, Alberta (Legal subdivision 3, section 4, township 24, range 1, west of 5th meridian).

Dentition.—A number of ptilodont teeth, found associated with the type specimen, appear to belong to a single species, and their proportions, compared with those of the P_4, strongly suggest identity with *"Ptilodus" cochranensis*. Assuming that these teeth do pertain to the same dentition as the P_4 of the present species, it is possible not only to amplify our knowledge of *"Ptilodus" cochranensis*, but also to refer the species to the genus *Ectypodus*,[6] which apparently replaces *Ptilodus* in the Upper Paleocene. It appears, therefore, that all the P_4 from the Paskapoo formation formerly referred to *Ptilodus* should be placed provisionally in *Ectypodus*.

P^4, viewed from above (fig. 1), is narrowly, and somewhat crescentically, ovoid in outline. The inner row of cusps runs diagonally from the antero-internal to the postero-external angle. There are eight cusps in this row. Seen from the side (fig. 2), these are elevated to form a trenchant ridge, which increases in height from the first to the seventh cusp. Behind this the ridge slopes away sharply, and the last cusp of the inner row is raised little above the base of the crown. Two cusps make up the outer row, with a suggestion of a third in front. These cusps show a slight tendency to form blades. The last one of the row, situated opposite the third cusp of the inner row, is the largest on the tooth. On the external side of this cusp the margin of the crown projects prominently outward. This P^4 shows the characteristic feature of the genus *Ectypodus*, i.e., the abbreviation of the external row of cusps. The corresponding tooth of *E. musculus*, the only other known species, has a relatively high internal cusp row, made up of seven tubercles, without a low one at the posterior extremity. The outer row in the P^4 of *E. musculus* has no trace of more than two cusps, and the last of these is located opposite the second cusp of the inner row.

M^1 is represented by a tooth (fig. 3) that is incomplete anteriorly. It is slightly larger than the M^1 of *E. musculus*, and differs in a few minor characters, such as the possession of only five cusps on the inner row.

M^2 (fig. 4) is known from two good specimens. These are larger than the corresponding tooth of *E. musculus*. The single external cusp of the present specimens is well separated at the antero-external angle, and is a cingulum-like ridge. There are three distinct cusps in the median row, the first forming a transverse ridge, the remainder conoid. The inner row consists apparently of three cusps, more or less joined together in a narrow longitudinal ridge.

P_4 is represented by a number of specimens, including the holotype of the species (fig. 5). Until the various teeth are found in association on the jaws, the P_4 is the only tooth that can be referred definitely to *E. cochranensis*. In the original description of this species P_4 was characterized as having fourteen marginal serrations, lateral ridges close together and nearly parallel to the long axis of the tooth, superior margin high and rounded, and comparatively slight anterior excavation for P_3. The more recently discovered specimens differ in having the

[6] Matthew and Granger, Amer. Mus. Nat. Hist., Novitates No. 13, p. 1. 1921; Granger and Simpson, Bull. Amer. Mus. Nat. Hist., vol. 56, pp. 652–656, figs. 35, 36. 1929.

lateral ridges more steeply inclined to the long axis of the crown, and in possessing a rudimentary fifteenth serration at the posterior end of the cutting edge.

The P_4 of *E. cochranensis* is larger than that of *E. musculus*, and has a rather different outline, as may be seen by comparing the figure given here with that published by Granger and Simpson. *Parectypodus simpsoni* Jepsen,[7] the closely related genus and species in the Lower Eocene, has a P_4 much the same in shape as that of *Ectypodus cochranensis*, but there are only twelve serrations on the cutting edge of the former.

The following are the measurements of the teeth described above: Length of P^4, 2.8 mm.; width of M^1, 1.4 mm.; length of M^2, 1.6 mm.; width of M^2, 1.6 mm.; length of P_4 (holotype), 4.9 mm.

Ectypodus? sp.

Ptilodus trovessartianus? Russell, Amer. Journ. Sci., vol. 17, p. 167, 1929.

One or more undescribed species of *Ectypodus* apparently are represented by a fragmentary M^1 and P_4 from locality 11, Cochrane, Alberta (Legal subdivision 4, section 1, township 26, range 4, west of 5th meridian) and a complete P_4 from locality 2E, Calgary, Alberta (Legal subdivision 3, section 4, township 24, range 1, west of 5th meridian). The molar, which is from the left side, is incomplete posteriorly. It resembles the M^1 of *E. musculus* as figured by Granger and Simpson, but apparently is almost three times as large. The length of the last six cusps in the outer row is 3.8 mm. The complete P_4 also resembles the corresponding tooth in *E. musculus* rather than that of *E. cochranensis*, but the length of the present specimen, 7.3 mm., is almost twice that of the P_4 of *E. musculus*.

Ptilodus? sp.

The only specimen suggesting the genus *Ptilodus* in the Paskapoo fauna is a single tooth, evidently a P^3 (fig. 6), from locality 11, Cochrane, Alberta. It bears six robust, subpyramidal cusps, arranged in two longitudinal rows. There is a considerable space between the supposed anterior end and the first pair of cusps. The present specimen is not unlike the P^3 of *Ptilodus gracilis* Gidley,[8] and is about the same size as that tooth. The length of the Paskapoo specimen is 3.2 mm., and the width, 2.3 mm.

Order INSECTIVORA Latreille

Family LEPTICTIDAE Cope

Genus Diacodon Cope

Diacodon septentrionalis Russell

Amer. Journ. Sci., vol. 17, p. 173, fig. 2. 1929.

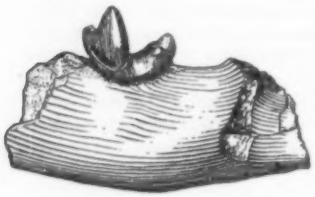
Holotype.—No. 126, Dept. of Geol., Univ. of Alberta, a jaw fragment with left M_2, locality 1, Cochrane, Alberta (Legal subdivision 7, section 4, township 26,

[7] Proc. Amer. Philos. Soc., vol. 69, p. 120, pl. 1, figs. 1–3, pl. 2, fig. 8. 1930.
[8] Proc. U. S. Nat. Mus., vol. 36, pp. 616–622, pl. 70. 1909.

range 4, west of 5th meridian). Paratypes: No. 333, U. of A., two incomplete lower right molars, locality 11, Cochrane, Alberta (Legal subdivision 4, section 1, township 26, range 4, west of 5th meridian). *Referred specimens:* three complete and two incomplete upper teeth from locality 11, Cochrane.

Dentition.—No additional data on the lower teeth of this species have been obtained as yet, but a drawing of the holotype is given here (fig. 7) for reference. The upper teeth mentioned above can be referred with some confidence to the genus *Diacodon*, and while more than one species probably is represented, all the specimens are of about the right size to be the upper teeth of *Diacodon septentrionalis* and are referred provisionally to that species.

P^4 may be represented by a tooth (fig. 10) that is narrow anteroposteriorly, and has a partly conjoined paracone and metacone, the former being the higher. The moderately high and pointed protocone has a compressed V shape. The intermediate cuspules have been removed by wear. There is a slight cingulum-like hypocone, and a smaller anterior cingulum. The external cingulum is well developed, and the metastyle projects outward. This tooth may be a true molar.



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ALBERTA LEPTICTIDAE, ×5. FIG. 7, *Diacodon septentrionalis*, holotype, jaw fragment with left M_3, external view. FIG. 8, *D. septentrionalis?*, probable left M^2, crown view. FIG. 9, *D. septentrionalis?*, probable right M^1, crown view. FIG. 10, *D. septentrionalis?*, probable right P^4, crown view.

The supposed M^1 is a somewhat larger tooth (fig. 9), with less anteroposterior compression. The paracone and metacone are well separated and the V-shaped protocone is of about the same height as the metacone. The two intermediate cusps are borne on the ridges of the protocone, and are well separated from paracone and metacone. Ledge-like cingula are well developed in front of and behind the protocone, and the posterior one bears a moderately prominent hypocone. The external border is rather straight, with slightly denticulate cingulum.

The tooth believed to be M^2 (fig. 8) resembles the supposed P^4 in being strongly compressed anteroposteriorly. The paracone and metacone are somewhat conjoined, the paracone being considerably higher. The protocone is almost as high as the paracone, and bears the intermediate cuspules on its V-shaped ridge. The anterior and posterior cingula show a tendency to be continuous around the internal side of the protocone, and a slight hypocone is present. The parastyle and metastyle both project outward, forming a median V-shaped notch in the outer margin.

The two remaining upper teeth are fragmentary, but resemble respectively the supposed M^1 and M^2 described above.

Dimensions.—Length of P^4?, 1.7 mm.; width of same, 2.7 mm.; length of M^1?, 3.0 mm.; width of same, 4.2 mm.; length of M^2?, 2.2 mm.; width of same, 3.7 mm.

Order CARNIVORA?

Family OXYCLAENIDAE Scott?

Genus and species undetermined

A rather well preserved upper molar, No. 340, U. of A. (fig. 11), from locality 11, Cochrane, Alberta (Legal subdivision 4, section 1, township 26, range 4, west of 5th meridian), is of such generalized structure as to be almost unidentifiable. The crown is subrectangular in outline. The cusps of the trigon are rather high and pointed, and the V-shaped protocone is placed somewhat anteriorly. There is a ledge-like anterior cingulum, and the pointed and prominent hypocone rests

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ALBERTA OXYCLAENIDAE?, ×5. FIG. 11, oxyclaenid?, gen. and sp. undet., upper molar, crown view. FIG. 12, *Chriacus?* sp., probable M^1, crown view.

on a rather broad posterior heel. There is no internal cingulum. The intermediate cuspules are small but distinct. A shallow median notch is present in the external margin of the crown. The tooth is 3.9 mm. long and 5.6 mm. wide.

This tooth has some resemblance to the more generalized upper molars of the Oxyclaenidae, such as those of *Oxyclaenus* and *Tricentes*, and is tentatively referred to this family. It is possible, however, that the specimen represents an undescribed insectivore.

Chriacus? sp.

A single tooth, No. 339, U. of A. (fig. 12), presumably a left M^1, was collected on the north bank of North Saskatchewan river, near Mile 113, Canadian National Railways, Nordegg Branch. This is in unsurveyed country, but apparently the location of the fossil is legal subdivision 1, section 30, township 39, range 10, west

[9] Allan, J. A., and R. L. Rutherford, Sci. Ind. Res. Coun. Alberta, Rept. No. 6, p. 51. 1923.

of the 5th meridian. This tooth is of considerable importance because of its stratigraphic position. It came from a shell bed in the Saunders formation about 1,000 feet above the Saunders coal series, that is, well down in what has been called the Upper Saunders formation.[9] These upper Saunders beds, throughout the central Alberta foothills, have been correlated with Upper Cretaceous formations farther east, either the Belly River or the Edmonton. The invertebrate fauna of the upper Saunders resembles that of the Paskapoo formation, but this fact has not been accepted as conclusive evidence of Tertiary age.

The tooth is without marked anteroposterior compression. The cusps of the trigon are rather high, the paracone and protocone being subequal, the metacone slightly lower. The basin of the trigon is deep. The protocone is inclined somewhat anteriorly, and bears on its V-shaped ridge the distinct intermediate cuspules. Anterior to the protocone is a slight cingulum. The posterior heel projects strongly inward and backward, but the hypocone that it bears is only of moderate size. The internal side of the protocone is without a cingulum. The external margin of the crown has a shallow median notch, and the parastyle and metastyle are not prominent. The anteroposterior length of the tooth is 2.8 mm., and the width is 3.6 mm.

As in the case of the Paskapoo tooth described above, one hesitates to decide whether the present specimen represents a creodont or an insectivore. However, the proportions of the crown, and the well separated external cusps are more suggestive of the former. The closest resemblance is to certain oxyclaenids, such as *Chriacus*, the present specimen comparing rather well with the M^1 of *Chriacus baldwini* (Cope).[10] In the latter tooth, however, the heel is less prominent, and the size is more than twice that of the Saunders fossil.

Since the present specimen was obtained from beds of supposed Upper Cretaceous age, it is necessary that comparisons be made with the Lance mammalian fauna. In this, however, the only form at all comparable is the probable leptictid *Gypsonictops hypoconus* Simpson.[11] The upper molars of this species, with their compressed trigons and small posterior heels, are even less like the Saunders fossil than are the corresponding teeth of Paleocene Leptictidae.

The writer's conclusions are that the present specimen is an oxyclaenid upper molar, related, if not pertaining, to the genus *Chriacus*. On the basis of our present knowledge it is not impossible, but extremely improbable, that the tooth is of Cretaceous age. Teeth of similar structure are rather characteristic of the Middle and Upper Paleocene faunas, and it is not likely that the present specimen is older. It is probable that it is about the same age as the mammalian faunas of the Paskapoo formation.

Geological Survey of Canada, Ottawa, Canada.

[10] Matthew, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 274, fig. 5. 1897.

[11] Amer. Mus. Nat. Hist., Novitates No. 267, pp. 6, 7, fig. 6, 1927; Mem. Peabody Mus., Yale Univ., vol. 3, pt. 1, pp. 137, 138, fig. 53, 1929.

A LEFT-SIDED INFERIOR VENA CAVA IN ECHIDNA ACULEATA

By Rupert A. Willis

The human inferior vena cava and its tributaries are subject to a number of developmental variations which depend on modifications of the mode of origin of the caval system from the various parts of the early posterior cardinal and subcardinal channels. Keith (1921) clearly summarizes this development, and gives references concerning the abnormalities observed. Robinson in Cunningham's Text Book of Anatomy (1915) also gives a useful summary of the various departures from the normal. One of these is total left-sidedness of the inferior vena cava, which then ascends through the left crus of the diaphragm, usurps the place of the left inferior and superior azygos veins, arches over the root of the left lung, and crosses the left atrium posteriorly to end in the right atrium at the same place as the coronary sinus. The following description concerns a similar condition encountered in some dissections of the Australian Echidna.

The accompanying diagrams render detailed description unnecessary. Both common iliac vessels terminate in a wide transverse venous anastomosis between the right and left renal veins. The vena cava commences from the left extremity of this transverse channel, where it lies posterior to the left adrenal gland. It then ascends through the left crus of the diaphragm and follows the course described in the previous paragraph. It receives as tributaries a number of separate left intercostal veins and a larger trunk, fig. 1, S. I., formed by union of the vessels from upper intercostal spaces. It also possesses small anastomotic communications with the lower parts of the right azygos vein. The hepatic vein makes a separate entry into the posterior aspect of the right atrium.

In the normal Echidna there is no oblique left innominate vein, both anterior cardinal vessels persisting as separate right and left superior venae cavae. In the specimen under discussion the left-sided inferior vena cava, after arching over the left pulmonary root, unites with the left superior vena cava, so that the venous trunk from this union to its entry into the atrium is really the fully persistent left duct of Cuvier. The tributary vessel S. I. cannot be the true homologue of the human left superior intercostal vein, which possesses a complex origin from the extra-pericardial portion of the duct of Cuvier and the terminal parts of both anterior and posterior cardinal vessels. A left-sided inferior vena cava in the Echidna, unlike that occurring in the human being, evidently

represents the whole of the thoracic part of the left posterior cardinal vessel. The primitive condition of the terminations of both cardinal veins in the duct of Cuvier has been completly retained. Presumably the vessel S. I. arose purely from the segmental intercostal channels.

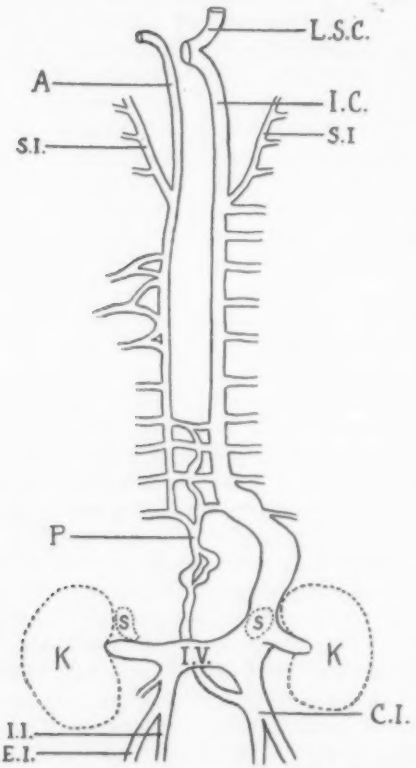

FIG. 1. Diagram of connections of the left-sided inferior vena cava. *A.*, azygos vein. *I. C.*, inferior vena cava *L. S. C.*, left superior vena cava. *S. I.*, venous trunk, draining upper intercostal spaces. *I. V.*, inter-renal vein. *C. I.*, *E. I.* and *I. I.*, common, external and internal iliac veins. *K.*, kidneys. *S.*, adrenals. *P.*, plexiform communication of left iliac vein with azygos system.

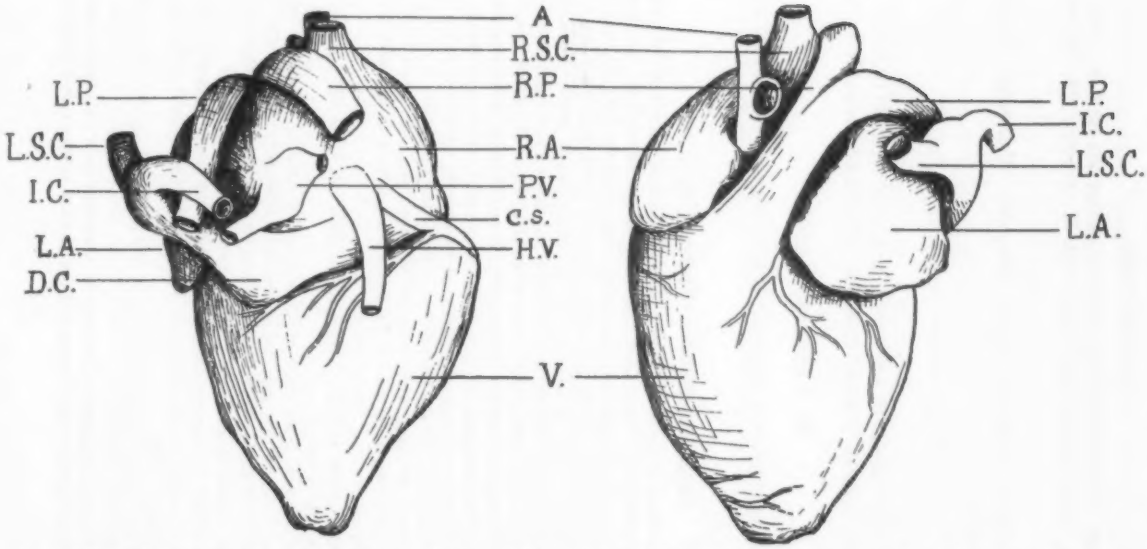

FIG. 2. Posterior and anterior views of heart. *R. A.* and *L. A.*, right and left atria. *V.*, ventricles. *R. S. C.* and *L. S. C.*, right and left superior venae cavae. *I. C.*, inferior vena cava. *D. C.*, left duct of Cuvier. *H. V.*, hepatic vein. *C. S.*, coronary sinus. *P. V.*, pulmonary veins. *L. P.* and *R. P.*, right and left pulmonary arteries. *A.*, aorta and innominate artery.

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Baker Research Institute, Alfred Hospital, Melbourne, Victoria, Australia.

A DESCRIPTION OF AN APPARENTLY NEW FORM OF CHIPMUNK FROM SOUTH KURILES, JAPAN

BY NAGAMICHI KURODA

The following chipmunk from the Kurile Islands seems to be undescribed:

Eutamias asiaticus okadae subsp. nov.

Characters.—Very different from *E. a. lineatus* of Hokkaido and Sakhalin in the coloration of the head, lower back, and rump, as well as the tail. The ground color of head, lower back and rump has a very deep intensely rusty-red tinge and is very much contrasted with the tail, which is nearly black with hoary tips to the hairs. The extreme bases of hairs on tail are cinnamon in color, this entirely hidden by the black and hoary parts, so that the tail shows no cinnamon when seen from above. The under side of tail rather resembles that of the allied forms, but the hoary margins predominate and the central cinnamon stripe is much obscured. The five black stripes on back are very conspicuous, without brownish wash, and the four paler stripes are also much deeper and not so buffy whitish as in the allied forms. The boundary between the color of sides of body and that of underparts is very well defined, the sides being rusty-red like the rump, and the entire underparts of body including inner side of the limbs being white, nearly without yellowish or buffy wash.

Measurements.—Head and body 147.5 (type), 150; tail 112.5 (type), 120; hind foot 33.5 (type), 35.5 mm.

Skull.—Not different from those of *lineatus* and *orientalis*. Greatest length, 39; condylobasal length, 33; zygomatic breadth (damaged); nasals, 12; interorbital breadth, 8.5; diastema, 10; palatilar length, 16.5; foramen incisivum, 2.5; length of upper molar series (on crown), 6.1 mm.

Type.—An adult in summer pelage; Mt. Chachanupuri, Kunashiri Island, South Kurile Islands, Japan; August 2, 1929; Yoshikazu Okada, collector; N. Kuroda collection no. 1382.

Note.—The new form is named in honor of the collector, who has donated the type specimen to my collection.

Remarks.—I have compared the forms of *Eutamias asiaticus* found in Sakhalin, Hokkaido, Kuriles, and Korea and found that *uthensis* and *lineatus* are

not separable when series of specimens are examined. Therefore I recognize the following three valid forms as occurring in the Japanese territories:

Eutamias asiaticus lineatus (Siebold), 1824.
Syn.—*E. asiaticus uthensis* (Pallas), 1831.
Habitat.—Sakhalin and Hokkaido.

Eutamias asiaticus okadae Kuroda, subsp. nov.
Habitat.—Kunashiri Island, S. Kuriles.

Eutamias asiaticus orientalis (Bonhote), 1899.
Habitat.—Korea. Also found in the Amur Region.

We have also four other forms in Russia, Siberia, and China.

Fukuyoshi Oho, Akasaka, Tokyo, Japan.

REVIEW OF WOOD RATS OF NEOTOMA LEPIDA GROUP

By E. A. Goldman

In his "Revision of the Wood Rats of the Genus Neotoma" (North Amer. Fauna, No. 31, pp. 79–80, October 19, 1910) the writer regarded the type locality of *Neotoma lepida* as unknown, and the typical form was assigned a range in northeastern Arizona and northwestern New Mexico. Subsequent study of the type specimen by several authorities, especially the carefully prepared notes, based upon the direct comparison of specimens by Remington Kellogg, and other considerations, indicate that, contrary to the earlier conclusions of the writer, the type came from Utah or Nevada and that the name has been misapplied to the Arizona animal.

The type specimen of *Neotoma lepida* has had a peculiar history, to which reference was made (l. c.). As number 3898 of the Smithsonian Institution it was regarded by Coues (Monographs North Amer. Rodentia, p. 24) in 1877 as an abnormally small individual of *Neotoma cinerea* and listed by him as from Williams Spring, Utah, with C. S. McCarthy as collector. After Coues examined it this specimen passed to the British Museum, where, as number 73.6.3.42, it became the basis of the original description of *Neotoma lepida* Thomas (Ann. and Mag. Nat. Hist., 6th Ser., vol. 12, p. 235, Sept., 1893), from "Utah." Examination of the catalogue of the Smithsonian Institution shows that the specimen was entered in the same handwriting as the preceding numbers, at the end of a general collection from various localities, received from J. H. Simpson and collected by C. S. McCarthy, who was the taxidermist for

Simpson's expeditions to the "Great Basin of Utah" (Rept. of Explorations across the Great Basin of Utah in 1859, 1876). The preceding number, 3897 from Williams Spring, Utah, was entered as "*Neotoma cinerea*" and ditto marks follow for number 3898, in the columns for the name of the species and those of Simpson and McCarthy, but the record is incomplete, and this is explained by the statement in the column for remarks that the specimen had "no label." The label, apparently supplied when the specimen was entered, March 7, 1860, bears the following data: "Smithsonian Institution, Washington, D. C. 3898. *Neotoma cinerea*. C. S. McCarthy," and on the back in pencil "Expl. in Utah. J. H. Simpson, U. S. A."

In March, 1904, specimens of *Neotoma arizonae*, *Neotoma desertorum*, and an unrecognized animal in the collection of the Biological Survey from Keams Canyon, Arizona, were submitted to Oldfield Thomas for comparison with the type of *lepida*. The Keams Canyon specimen was found to agree in many respects, and, in view of the uncertainty regarding the type was assumed to represent typical *lepida*. Field work has since indicated, however, that the Keams Canyon animal is specifically distinct and does not occur in the region visited by Simpson's expeditions which, as the detailed report and map shows, covered routes from Camp Floyd, in the vicinity of Salt Lake City, Utah, to Carson City, Nevada, passing well to the northwest of the Sevier River valley. The Keams Canyon species appears to be restricted to the region east of the Colorado River.

Three specimens from Keams Canyon, Arizona, and three from Utah have recently been compared by Kellogg with the type of *N. lepida* in the British Museum. Two of the Utah specimens were from Marysvale and one from the Henry Mountains, all representative of the widely distributed form which has been passing as *desertorum*. The type of *N. lepida* was found to be considerably faded, but in general tone and sharply bicolor tail to resemble *desertorum*. The tail was also found to agree with that of *desertorum* in hairiness, instead of with the longer haired appendage of the Keams Canyon animal. Perhaps the most conclusive evidence, however, of the specific identity of the type of *lepida* with *desertorum* is presented by the skull. The basicranial portion of the skull as far forward as the palatal notch is missing, but the cranial characters that can be studied, and especially such dental features as the more oblique (compared with Keams Canyon specimens) enamel loops of the anterior upper molar are those of *desertorum*. Kellogg, referring to the three specimens from Utah, concludes: "Thus it is evident that the

series now labelled *N. desertorum* should be correctly known as *N. lepida.*" Gerrit S. Miller, Jr. and W. H. Osgood have also at different times examined the type of *N. lepida* and expressed the opinion that it is specifically identical with *desertorum.*

Further indication that the type of *N. lepida*, which had no label when entered in the Smithsonian catalogue, was taken by McCarthy on the Simpson expeditions is the fact that, as the catalogue shows, it was not unusual for specimens obtained by him to be received in that condition.

The assumption by Coues (l. c.) that the specimen came from Williams Spring, shown on Simpson's map as situated about 40 miles southwest of Utah Lake, seems to be based on the mere chance that the preceding entry in the Smithsonian catalogue was from that locality. Much of the route of the Simpson expeditions was through the range of *desertorum* and the type specimen of *N. lepida* might have been taken at any one of many points visited by McCarthy between Camp Floyd, Utah, and Carson City, Nevada.

The conclusion that the type of *N. lepida* came from Utah or Nevada and that the Arizona animal mentioned is specifically distinct leaves the latter without a name. In accordance with the rule of priority it also necessitates the recombination of a number of names. The following is a rearrangement of what may properly be designated as the *Neotoma lepida* group of wood rats. It combines the "*Neotoma intermedia*" and "*Neotoma desertorum*" groups as formerly treated by the writer (l. c.), and regarded as distinct until intergradation was detected by Grinnell and Swarth (Univ. Calif. Pub. Zool., vol. 10, p. 236, 1913).

LIST OF SPECIES AND SUBSPECIES

Neotoma lepida Thomas

[Synonymy under subspecies]

Distribution.—From southeastern Oregon and northeastern California south through Nevada, southern California, and Lower California to Cape San Lucas; east mainly west of the Colorado River through Utah and northwestern Arizona to northwestern Colorado, but one form invading limited areas in the Painted Desert region and extreme western Arizona east of the Colorado River.

Neotoma lepida lepida Thomas

Neotoma lepida Thomas, Ann. Mag. Nat. Hist., ser. 6., vol. 12, p. 235, September, 1893. Type from somewhere on "Simpson's route" between Camp Floyd (a few miles west of Utah Lake), Utah, and Carson City, Nevada.

Neotoma desertorum Merriam, Proc. Biol. Soc. Washington, vol. 9, p. 125, July 2, 1894. Type from Furnace Creek, Death Valley, Inyo County, California.

Neotoma bella Bangs, Proc. New Eng. Zool. Club, vol. 1, p. 66, July 31, 1899. Type from Palm Springs, Riverside County, California.

Neotoma nevadensis Taylor, Univ. Calif. Publ. Zool., vol. 5, p. 289, pls. 27–29, February 12, 1910. Type from Virgin Valley, Humboldt County, Nevada.

Distribution.—Desert regions east of the high mountains in southeastern California, central, southern, and eastern Nevada, and east through northwestern Arizona and Utah west of the Colorado River, to northwestern Colorado.

Remarks.—*Neotoma desertorum* and *N. nevadensis* seem inseparable from *N. lepida* as now understood. *N. bella* may be placed in synonymy here, but it is from the narrow area of intergradation between *lepida* and the animal described as *Neotoma intermedia gilva*, and, as a topotype strongly suggests, might with similar propriety be assigned to the synonymy of the latter.

Neotoma lepida devia Goldman

Neotoma intermedia devia Goldman, Proc. Biol. Soc. Washington, vol. 40, p. 205, Dec. 2, 1927. Type from Tanner Tank, Painted Desert, Arizona. Altitude 5,200 feet.

Distribution.—Known only from a narrow strip along the eastern side of the Colorado River extending from points in the Painted Desert south through the Grand Canyon to Parker, western Arizona.

Remarks.—The apparently limited occurrence of this form suggests that it is an invader from the main range of the species west of the Colorado River. Its range presents another interesting example of the effectiveness of the Colorado as a barrier to the passage of such rodents, except under extraordinary conditions such as must have enabled it to gain a foothold on the eastern side, where it has become markedly differentiated.

Neotoma lepida monstrabilis subsp. nov.

Type.—From Ryan, Kaibab National Forest, Coconino County, Arizona (altitude 6,000 feet). No. 243123, ♂ adult, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, October 10, 1922. Original number 23379.

Distribution.—Southern Utah and northwestern Arizona west of the Colorado River.

General characters.—Similar to *Neotoma lepida lepida*, but upper parts much richer in color, more suffused with pinkish instead of light ochraceous buff. More buffy than *N. l. devia*, from the opposite side of the Colorado River, and skull differing in detail.

Color.—*Type:* Upper parts in general rich pinkish buff (Ridgway, 1912), purest on cheeks, shoulders, and sides, the top of head and back moderately mixed or lined with black; under parts white, tinged across abdomen with very pale buff; sides of neck near fore limbs rich pinkish buff; ears clothed internally and externally with short, fine, brownish gray hairs; outer sides of forearms and hind legs rich pinkish buff, the feet white; tail sharply bicolor, brownish gray above, white below.

Skull.—Essentially as in *N. l. lepida*, but braincase usually larger, more rounded and inflated. Compared with that of *N. l. devia* the skull differs as fol-

lows: Interparietal less extended antero-posteriorly; nasals usually narrower posteriorly; incisive foramina usually longer than palatal bridge (about equal to palatal bridge in *devia*).

Measurements.—Type: Total length, 288 mm.; tail vertebrae, 125; hind foot, 31. Two adults from Thunder River, Grand Canyon National Park: total length, 290, 300; tail vertebrae, 126, 142; hind foot, 31, 31.5. *Skull* (type): Greatest length, 39.6 mm.; condylobasal length, 37.7; zygomatic breadth, 20.9; interorbital breadth, 5.4; length of nasals, 14.3; length of incisive foramina, 8; length of palatal bridge, 7; length of interparietal (median line antero-posteriorly), 4.3; maxillary tooth row (alveoli), 8.

Remarks.—The rich pinkish buff general tone of the upper parts readily distinguishes *N. l. monstrabilis* from all of its relatives. It occurs from 2,000 feet in the bottom of Grand Canyon along the western side of the Colorado River up to 6,000 feet altitude in the mountains of southern Utah, intergrading farther north and west with typical *lepida*. The Colorado River sharply separates its range from that of *devia* which inhabits the eastern or southern side of the Grand Canyon, and other points along or near the eastern side of the stream.

Specimens from Littlefield and the Virgin Mountains are less vividly colored than usual in *monstrabilis* and grade toward typical *lepida*. The present form presents some of the same color variations observed in typical *lepida* and related forms. Specimens from certain localities, as in the vicinity of Mount Trumbull, are essentially dichromatic, although the line of demarcation between the two color phases is not always sharply defined. Along with normally colored individuals occur others that exhibit excessive pigmentation, especially of the parts of the body over which the basal color of the fur is normally dark. In such specimens the back is more heavily overlaid with black, the buffy element of the upper parts is reduced but increased on the under parts over areas on which the basal color of the pelage is normally dark. In normal specimens the abdomen is white or very pale buff, the fur becoming plumbeous basally. In the dark phase the abdomen is overlaid with rich pinkish buff, and the tail may be nearly black above and abnormally dark below. Pure white pectoral and inguinal areas are common to both color phases.

Specimens examined.—Total number, 43, as follows:

ARIZONA: Bright Angel Creek (mouth), Grand Canyon, 1; Diamond Butte, 3; Fredonia, 1; Grand Wash (8 miles south of Pakoon Spring), 2; Hurricane Ledge (6 miles north of Mount Trumbull), 3; Jacob's Pools, Houserock Valley, 2; Lee's Ferry (west side of river), 5; Lefevre Canyon, Kaibab National Forest, 1; North Canyon, Houserock Valley, 1; Littlefield, 1; Ryan (type locality), 1; Shinimo Creek, Grand Canyon, 8; Soap Creek (15 miles southwest of Lee's Ferry), 1; Thunder River (3 miles above mouth), Grand Canyon, 1; Trumbull Mountains (3 miles south of Trumbull Spring), 1; Virgin Mountains (Elbow Canyon), 2.

UTAH: Kanab, 2; Mount Ellen, Henry Mountains, 4; Saint George, 3.

Neotoma lepida gilva Rhoads

Neotoma intermedia gilva Rhoads, Amer. Nat., vol. 28, p. 70, January, 1894. Type from Banning, San Bernardino County, California.

Neotoma desertorum sola Merriam, Proc. Biol. Soc. Washington, vol. 9, p. 126, July 2, 1894. Type from San Emigdio, Kern County, California.

Distribution.—Arid plains and mainly eastern basal slopes of mountains in a narrow strip between the ranges of *N. l. lepida* and *N. l. intermedia*, from Stanley on the western side of the San Joaquin Valley, California through the low passes of the southern Sierra Nevada and south to near the Mexican boundary.

Remarks.—*N. l. gilva* is an intergrading form connecting *N. l. lepida* and *N. l. intermedia*. It is characterized by a combination of the pale color of *lepida* with the shorter, coarser pelage and cranial features of *intermedia*.

Neotoma lepida intermedia Rhoads

Neotoma intermedia Rhoads, Amer. Nat., vol. 28, p. 69, January, 1894. Type from Dulzura, San Diego County, California.

Neotoma californica Price, Proc. Calif. Acad. Sci., 2 Ser., vol. 4, p. 154, pl. 11, May 9, 1894. Type from Bear Valley, San Benito County, California.

Distribution.—Lower slopes of southern part of the Sierra Nevada and the coast region of California from Monterey Bay south to northwestern Lower California.

Remarks.—Two forms here listed under the names *ravida* and *notia* were formerly included by the writer in the general range of *intermedia*.

Neotoma lepida felipensis Elliot

Neotoma bella felipensis Elliot, Publ. Field Columb. Mus., Zool. Ser., vol. 3, p. 217, June, 1903. Type from San Felipe, Lower California, Mexico.

Distribution.—Desert region, east of the San Pedro Martir Mountains, in northeastern Lower California.

Remarks.—This form, treated by the writer in revising the genus as synonymous with *gilva*, is now regarded as worthy of recognition. It has a limited but definite range and contrasted with *gilva* is characterized externally by extreme pallor, and apparently larger ears. The skull is very similar to that of *gilva*, but usually more angular, the rostrum and incisors averaging broader and heavier. In addition the audital bullae average slightly larger, more rounded and inflated, the anterior border of the meatus tending to project more prominently. In the size and form of the bullae, relationship to typical *lepida* is suggested.

Neotoma lepida ravida Nelson and Goldman

Neotoma intermedia ravida Nelson and Goldman, Proc. Biol. Soc. Washington, vol. 44, p. 107, October 17, 1931. Type from Comondú, Lower California, Mexico. Altitude 700 feet.

Distribution.—Volcanic region, including extensive lava beds, along the backbone of the peninsula of Lower California, from about latitude 28 degrees south to the Sierra de la Giganta.

Neotoma lepida pretiosa Goldman

Neotoma intermedia pretiosa Goldman, Proc. Biol. Soc. Washington, vol. 22, p. 139, June 25, 1909. Type from Matancita (also called Soledad), 50 miles north of Magdalena Bay, Lower California, Mexico. Altitude 100 feet.

Distribution.—West coast and islands of Lower California, from San Jorge (southwest of Comondú) south to Margarita Island.

Neotoma lepida notia Nelson and Goldman

Neotoma intermedia notia Nelson and Goldman, Proc. Biol. Soc. Washington, vol. 44, p. 108, October 17, 1931. Type from La Laguna, Sierra de la Victoria, Lower California, Mexico. Altitude 5,500 feet.

Distribution.—Known only from the mountains of the Cape region of Lower California.

Neotoma lepida arenacea Allen

Neotoma arenacea Allen, Bull. Amer. Mus. Nat. Hist., vol. 10, p. 150, April 12, 1898. Type from San José del Cabo, Lower California, Mexico.

Distribution.—Coastal plains and basal mountain slopes in the Cape region of Lower California, north at least to La Paz.

Neotoma lepida vicina Goldman

Neotoma intermedia vicina Goldman, Proc. Biol. Soc. Washington, vol. 22, p. 140, June 25, 1909. Type from Espiritu Santo Island, Gulf of California, Lower California, Mexico.

Distribution.—Espiritu Santo Island, Lower California.

Neotoma lepida perpallida Goldman

Neotoma intermedia perpallida Goldman, Proc. Biol. Soc. Washington, vol. 22, p. 139, June 25, 1909. Type from San José Island, Gulf of California, Lower California, Mexico.

Distribution.—San José Island, Lower California.

Neotoma abbreviata Goldman

Neotoma abbreviata Goldman, Proc. Biol. Soc. Washington, vol. 22, p. 140, June 25, 1909. Type from San Francisco Island (near southern end of San José Island, Gulf of California, Lower California, Mexico.

Distribution.—San Francisco Island, Lower California.

Neotoma nudicauda Goldman

Neotoma nudicauda Goldman, Proc. Biol. Soc. Washington, vol. 18, p. 28, February 2, 1905. Type from Carmen Island, Gulf of California, Mexico.

Distribution.—Carmen Island, Lower California.

Neotoma insularis Townsend

Neotoma insularis Townsend, Bull. Amer. Mus. Nat. Hist., vol. 31, p. 125, June 14, 1912. Type from Angel de la Guarda Island, Gulf of California, Lower California, Mexico.

Distribution.—Angel de la Guarda Island, Lower California.

Neotoma bryanti Merriam

Neotoma bryanti Merriam, Amer. Nat., vol. 21, no. 2, p. 191, February, 1887. Type from Cedros Island, off west coast of Lower California, Mexico.

Distribution.—Cedros Island, Lower California.

Neotoma anthonyi Allen

Neotoma anthonyi Allen, Bull. Amer. Mus. Nat. Hist., vol. 10, p. 151, April 12, 1898. Type from Todos Santos Island, off west coast of Lower California, Mexico.

Distribution.—Todos Santos Island, Lower California.

Neotoma martinensis Goldman

Neotoma martinensis Goldman, Proc. Biol. Soc. Washington, vol. 18, p. 28, February 2, 1905. Type from San Martin Island, off west coast of Lower California, Mexico.

Distribution.—San Martin Island, Lower California.

Neotoma stephensi Goldman

[References under subspecies]

Distribution.—Upper Sonoran Zone from the outlying Harquahala and Hualpai Mountains in western Arizona east through the plateau region of the central part of the state to the Burro Mountains, New Mexico, and north over the Painted Desert area to northeastern Arizona and northwestern New Mexico.

Remarks.—*N. stephensi* and *N. lepida* are similar in the more essential general characters, especially the important cranial and dental features and are apparently referable to the same group. Marked differences in detail, however, are exhibited, and specific distinction is proven by the occurrence of the two in close proximity, with no evidence of intergradation, along the eastern walls of the Grand Canyon. The range of *stephensi* appears to be bounded on the west by the Colorado River. *N. stephensi* compared with *lepida* differs as follows: Color, especially flanks, light ochraceous buff or yellowish, instead of pinkish buff; tail longer haired, less sharply bicolor; skull broader and flatter between orbits, the supraorbital ridges less upturned; nasals usually broader posteriorly; interpterygoid fossa usually broader; upper incisors usually more strongly recurved; molars usually slightly broader; enamel loops, especially in anterior upper molar, less oblique; outer reentrant angles in first upper molar opening less widely.

Neotoma stephensi stephensi Goldman

Neotoma stephensi Goldman, Proc. Biol. Soc. Washington, vol. 18, p. 32, February 2, 1905. Type from Hualpai Mountains, Arizona. Altitude 6,300 feet.

Distribution.—From the Harquahala and Hualpai Mountains in western Arizona east along the slopes of the Mogollon plateau to the Burro and Zuni Mountains in western New Mexico.

Neotoma stephensi relicta subsp. nov.

Type.—From Keams Canyon, Navajo County, Arizona. No. 67780, ♀ adult, U. S. National Museum (Biological Survey collection), collected by A. K. Fisher, July 22, 1894. Original number 1649.

Distribution.—Plateau region of northeastern Arizona, north of the Little

Colorado River, and northwestern New Mexico south to Gallup, grading to the southward into *N. s. stephensi*.

General characters.—Similar to *N. s. stephensi*, but smaller; color decidedly paler, more buffy, the upper parts less mixed with black; tail slightly bushy, as in *stephensi*.

Color.—Type: Upper parts light ochraceous buff (Ridgway, 1912), purest on cheeks, shoulders, outer surfaces of forearms and hind legs, and along flanks, becoming pale buffy gray on middle of face, the top of head and back rather thinly overlaid with black; under parts and feet white; ears thinly clothed with short, grayish brown hairs; tail indistinctly bicolor, grayish brown above, becoming gradually dull whitish below.

Skull.—Closely resembling that of *N. s. stephensi*, but smaller, with relatively smaller interparietal, shorter toothrows, and smaller incisors; first upper molar with antero-internal reentrant angle shallow or absent (usually absent), as in other members of the *lepida* group.

Measurements.—Type: Total length, 312 mm.; tail vertebrae, 141; hind foot, 28. Average of five adult topotypes: 296 (274–312); 131 (115–149); 29 (28–30). *Skull* (type): Greatest length, 40.3; condylobasal length, 38; zygomatic breadth 20.2; interorbital breadth, 5.4; length of nasals, 14.8; incisive foramina, 9; length of palatal bridge, 7.1; maxillary toothrow (alveoli), 7.7.

Remarks.—The form here treated as new has hitherto erroneously been regarded as typifying *N. lepida*, as set forth in the introduction. It requires close comparison only with *N. s. stephensi*.

Specimens examined.—Total number, 32 as follows:

ARIZONA: Cedar Ridge (30 miles north of Tuba), 1; Keams Canyon (type locality), 20; Saint Michaels, 2; Tuba, 1.

NEW MEXICO: Blanco, 1; Bluewater, 1; Fort Wingate, 3; Gallup, 1; Wingate, 2.

Neotoma goldmani Merriam

Neotoma goldmani Merriam, Proc. Biol. Soc. Washington, vol. 16, p. 48, March 19, 1903. Type from Saltillo, Coahuila, Mexico. Altitude 5,000 feet.

Distribution.—Desert regions in southern Coahuila, Mexico.

Remarks.—Although the known geographic range of *N. goldmani*, the smallest of wood rats, is remote it is clearly a member of the *lepida* group as here restricted. In external appearance, especially the short-haired, bicolored tail, it resembles *N. lepida*, but in cranial details it more nearly approaches *N. stephensi*.

United States Biological Survey.

THE RESPIRATORY RATE OF THE COMMON PORPOISE

By G. H. Parker

That porpoises may be successfully kept in confinement was shown some years ago by Townsend (1916) who exhibited in the large central pool of the New York Aquarium for a period of some twenty-one months a living bottle-nosed porpoise (*Tursiops truncatus*). The common porpoise, *Phocæna phocæna*, has also been reported from time to time as successfully held in captivity for longer or shorter periods. Notwithstanding these opportunities, no one, so far as I am aware, has recorded the respiratory rate of these cetaceans. Determinations of this kind would be of interest because of the unusual specialization of these mammals for aquatic life.

During the early summer of 1929 at the Woods Hole Laboratory of the United States Bureau of Fisheries, a common porpoise about a meter and a half in length was captured and put in an outside seawater pool some 28 meters long by 7 wide. The animal lived in this pool for about a week, swimming complacently back and forth. It finally died from an unknown cause. In the early morning, before visitors had arrived, it could be watched with comparative ease and records of the period of time between its respiratory movements could be taken with a stop-watch. The porpoise swam ordinarily just below the top of the water. As the time for breathing approached, it rose and, on cutting the surface, opened its nostril, discharged air from its lungs with a low hissing noise, took in a fresh supply, closed its nostril, and dove again below the surface. The whole operation of breathing consumed only a few seconds. The noise attendant on cutting the surface of the water and especially on discharging the air from the lungs was so obvious that in the quiet of the early part of the day continuous records of the respiratory intervals were easily made. The stop-watch used gave readings to two-tenths of a second. Each record marked the interval of time between the beginning of a given respiratory act and the beginning of the next one. In each record, almost exactly a second and a half were lost stopping, reading, and resetting the watch, and this interval has been added as a correction in the final statement of the results.

A total of three sets of records was completed while the porpoise was in a vigorous condition. The first one included 51 observations and gave a respiratory interval that when corrected averaged 16.53 seconds; the second included 33 observations and averaged 13.68 seconds; and the third was of 56 observations and averaged 15.59 seconds. All three sets

when taken together yielded the following general results. The shortest respiratory interval was 6.5 seconds, the longest 31.7 seconds. The general average for the series was 15.48 seconds and the modal interval was 13.1 seconds. It may therefore be stated that in quiet swimming, the common porpoise breathes on the average once in 15.48 seconds or about four times a minute.

This determination agrees fairly well with Jolyet's statement, as quoted by Babák (1921, p. 1013), that a confined dolphin, *Tursiops tursio* [= *T. truncatus*], breathed one to three times a minute. This creature, however, was said to have been in a very abnormal position in which to respire, and soon died. My determination of four breaths a minute for the porpoise is more rapid than that given by Kükenthal for dolphins (*Delphinus delphis* and *Tursiops truncatus*) in the open sea, namely, one respiration every three minutes. But it must be remembered that these dolphins are much larger than the common porpoise and should be expected, therefore, to breathe more slowly. Moreover, observations on animals in the open are less certain than those on creatures in a confining pool where it is much less likely that a respiratory discharge may be missed. Hence Kükenthal's interval may be somewhat too long. Both Jolyet and Kükenthal note that dolphins may remain under the water for much longer periods than those just mentioned, Jolyet setting the maximum at about fifteen minutes. On this point, my observation for the porpoise of 31.7 seconds is surely far short of what may be expected. The average respiratory rate of the porpoise, four breaths per minute, is much lower than that of the normally resting human being, 17 to 18 breaths per minute, and yet these two organisms are not very different in weight. The dissimilarity in their breathing rates is doubtless indicative of the adaptation of the porpoise to its relatively novel environment. This adaptation is in rough agreement, when relative weights and degrees of activity are taken into account, with that of the Florida manatee, whose average period of submergence, when resting, is about eight and a half minutes (Parker, 1922).

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Zoölogical Laboratory, Harvard University.

GENERAL NOTES

NOTES ON MAMMALS OF THE CARLSBAD CAVERN REGION

In the summer of 1930, it was the writer's privilege to visit the Carlsbad Cavern region, New Mexico, as a member of a collecting party under the supervision of Mr. C. D. Bunker, working in the interests of the University of Kansas Museum. The following observations made during the course of the summer may be of interest.

July 24, 1930, the party visited the Harrison Ranch, 34 miles southwest of Carlsbad, to collect species which might be attracted by the large spring, known locally as "Rattlesnake Springs." We were told by the owners that there were rats which nested in trees in the orchard, and, remembering the experiences recorded by Mr. Frank F. Gander (Journ. Mamm., vol. 10, pp. 52–58), we investigated. The nests were in apple trees. One, which we examined rather closely, was about eight feet from the ground. It was approximately three feet six inches in diameter, about one foot thick, and looked like a flat mass of sticks. It was composed largely of apple twigs, the top twigs having green leaves on them. The writer stirred up the nest, until an adult wood rat ran out, and Mr. Louis W. Coghill, who was standing on the ground, collected it. There was only the one individual in the nest, and the skin is now in the collection of the University of Kansas Museum. It has been referred to *Neotoma micropus canescens*.

While the party was encamped at the mouth of the "Bat Cave," a branch of the big Carlsbad Cavern, it was decided to set some traps down in the cave, in the runways indicated by tracks in the guano. Out of twenty traps baited with rolled oats, the writer obtained ten house mice. This was a surprise, as we expected to get *Peromyscus leucopus tornillo*, such as Mr. Vernon Bailey found in the cave when obtaining material for his excellent monograph on the region (Monographs of the Amer. Soc. of Mammalogists, No. 3, Animal Life of the Carlsbad Cavern, p. 69). Of the ten specimens taken, all, save one, had been mutilated beyond saving by the cave crickets. The one skin is in the collection of the University of Kansas Museum.

August 6, 1930, we were conducted to McKittrick Cave, about fifteen miles west of Carlsbad, by Mr. Marvin Livingston. We collected about 150 bats in this cave, but, with the exception of one specimen, none of them were *Corynorhinus macrotis pallescens*, the species found hibernating there by Mr. Bailey, April 15, 1924 (*Op. cit.*, pp. 120–121). In the field, the others were referred to *Myotis incautus* and *Myotis thysanodes*. Skins and skeletons of these specimens are in the collection of the University of Kansas Museum.

August 9, we visited the cave in Dow's Pasture, about five miles southwest of Carlsbad, known locally as "Dead Man's Cave," in hopes of collecting specimens of *Myotis incautus*, which was found there May 2, 1924, by Mr. Bailey (*Op. cit.*, p. 124). We found the cave deserted, but there were plenty of signs on the ceiling and floor showing the former presence of bats.—Harry C. Parker, *Worcester Museum of Natural History, Worcester, Mass.*

LARGE BROWN BAT IN MICHIGAN

On June 19, 1931, workmen engaged in clearing away some trees interfering with the erection of Kingswood School, Bloomfield Hills, Michigan, felled a large black

oak. The fall shattered the trunk about thirty feet above the base and the men found in the hollow shell near that point a number of large brown bats (*Eptesicus fuscus fuscus*). Some bats made their escape, but the men caught several and sent them to the Cranbrook Institute of Science. These proved to be one male and four female adults, and two young able to crawl about with some facility. Three of the females had one or two young each clinging to her. All the young were naked. The following day I found that the fourth female adult had given birth to a single young, which was very tiny and feeble. The bats were kept for nearly a week, but were released when it became evident that the food (insects attracted to the cage by a light) was not sufficient.

The capture of these bats with young indicates that the animals have not entirely given up their old habits and still use trees as dwelling places, and that the time of birth, for southern Michigan, is around the middle of June.—Victor H. Cahalane. *Cranbrook Institute of Science, Bloomfield Hills, Michigan.*

BIG-EARED BAT IN THE GRAND CANYON

Another species of bat, making a total of ten that have been recorded from the Grand Canyon National Park, has recently been added to the rapidly increasing faunal list of this area. On the evening of June 15, 1931 a specimen of the big-eared or desert pallid bat (*Antrozous pallidus pallidus*) was collected on the south rim of the Grand Canyon. It had a wing spread of nearly 13¼ inches. Other measurements were as follows: Total length, 4.4 inches; tail, 1.9 inches; hind foot, 0.4 inch; forearm, 2.1 inches; ear from meatus, 1.2 inches.—Edwin D. McKee, *Park Naturalist, Grand Canyon National Park, Arizona.*

WHEN DO WEASELS MATE?

This question occurred to me when camped at Lake Brennan, Gunnison County, Colorado, 10,300 feet elevation. On August 28, 1930, my companion, Arthur Cool, killed a male mountain weasel, *Mustela arizonensis;* unfortunately he shot it through the hindquarters with a .22 cal. rifle and that part of the body was badly mutilated. One testicle was hanging by a shred and was so large that it made me wonder if the weasels, like their near relatives, the martens, mated in summer. I had always taken it for granted that the mating took place the latter part of the winter. More recently I have consulted what books were at my command, and made various inquiries without getting any light on the subject. Mr. Cool said there were two of the animals and that they appeared to be fighting. The one killed had the other down on its back and was biting its throat, while the victim squealed as if in pain. Unfortunately he was unable to secure this one.

Early in August, 1931, I was on the Grand Mesa in Colorado, also at an elevation of some 10,000 feet. On August 2, John Nagel, my companion, killed a fine male weasel whose testicles were large, being with the scrotum as large as those of the ordinary house cat. This served to confirm my previous conclusion. An interesting thing about this specimen is that there was a short porcupine quill sticking in the skin near the mouth and another in the skull. What was the weasel doing with the porcupine?

On the 6th, at another locality on the Mesa, Nagel took a female weasel whose external generative parts showed no signs of breeding activity. The following day, at the same place, he took a male, whose testes were not visible externally

and were less than half the size of those of the first one, even though it was a somewhat larger animal. It was certainly full grown, as was the female. Thus my evidence is rather inconclusive, and I would be glad if others would throw light on the subject.—Edward R. Warren, *1511 Wood Avenue, Colorado Springs, Colo.*

SWIMMING CATS

Recently while reading that most charmingly written of all of Dr. Frank M. Chapman's delightful books, My Tropical Air Castle, I came across this passage (p. 231): "I have yet to find any evidence that Ocelots, Pumas or Peccaries cross these esteros, and if they avoid a stream a few yards wide it does not seem probable that they would swim to the mainland." He refers, of course, to local conditions on Barro Colorado Island, but I am reminded that about three years ago I had occasion to search the literature—with surprisingly little success—for instances of voluntary swimming on the part of the larger cats. Although the fact may be well known to naturalists that some cats are strong swimmers, specific instances in the literature seem to be almost entirely wanting. Actually I find but six references to natatorial habits among the cats, and most of these are only incidental remarks, while one is even contradictory. There is little to wonder at then in the persistence of the idea that abhorrence of water is a cardinal feline trait.

Humboldt, camping for the night of April 6, 1800, on a barren island in the Orinoco below the mouth of the Arauca, was surprised to find that jaguars swam to the island although fires had been kindled to prevent that very contingency. Flower and Lydekker, in their Introduction to the Study of Mammals Living and Extinct, 1891, p. 503, say of the cats that "none are aquatic, and all take to the water with reluctance." Subsequently Lydekker reversed the last clause, thus: "Like the other large cats, the jaguar takes to water readily, and swims well" (The New Natural History, Vol. I, 1901, p. 400). Daniel J. Singer, in Mammals of America, Vol. IV, Nature Lovers Library, 1917, p. 151, states: "The Jaguar swims well and does not hesitate to follow turtles into the water." The only author to give more than a perfunctory sentence to the subject, however, is Ernest Thompson Seton. Writing of the jaguar in his classic Lives of Game Animals, Vol. I, 1925, p. 24, he says: "It seems to be a rule that none of the tropical Cats have any fear of water. It is well known that all of the felines love to be warm. They have not the fur to resist the wet, so in cold regions avoid the water. The Jaguar in its equatorial home is credited with many aquatic ways. It will swim rivers of any width when they lie across its path. It will dash into the water to attack an enemy, and is said by many observers to be an adept at catching fish." Of the puma the same author writes (*op. cit.*, p. 94): "The Cougar shows little fear of wa er. Indeed, he crosses it, lake or river, fast or slow, summer or winter, when er it suits his purpose to get to the other side. O. O. Smith describes the plung of the mother Cougar into the icy Pilchuck to come to the rescue of her cub; nd J. C. Hughes of New Westminster, B. C., says he knew of 2 Panthers killed while crossing the Fraser River where it was nearly a mile wide."

My own experience tends to corroborate the last author's statements, and it may perhaps be well to put on record two instances of the voluntary swimming of *Felis* that have come under my notice.

In September, 1926, while my wife and I were voyaging down the Rio Araguaya, in central Brazil, a small round object was noticed bobbing about in midstream some distance away. Drawing nearer we were astonished to find that the object was the head of a swimming jaguar making straight for the western bank. One of our Indians dispatched the animal with a shotgun, when it was found to be an adult female. The river here was very wide, certainly more than a mile across. As this was in the wildest stretch of the Araguaya, uninhabited except by the Carajá Indians, who are strictly fluvial people, it seems hardly possible that the jaguar could have been pursued by dogs or any other enemy capable of driving it into the river. It must be concluded, therefore, that the animal succumbed to the universal appeal of the greener grass on the other side of the fence and deliberately set out to see about it.

The other instance occurred when we were returning last year from the Alto Orinoco. In late February, 1930, the governor's launch, returning from Ciudad Bolívar to the territorial capital, Puerto Ayacucho, encountered a puma in midstream in the neighborhood of the Parguaza Hills. The Orinoco here is at least a mile wide. This animal too was swimming from east to west, and when intercepted by the launch it became confused and tried to climb aboard—to the utter consternation of the crew. So great was the excitement that although a number of shots were fired at the poor beast from a distance of only a few feet, not one took effect! I did not actually see this occurrence, but had the facts from the motorist of the launch while they were still fresh. Although there are a few scattered settlements along this part of the Orinco, it seems unlikely in this case also that the puma could have been cornered and driven into the river.—ERNEST G. HOLT, *312 Bell Building, Montgomery, Alabama.*

GROUND SQUIRRELS INVADING NEW TERRITORY IN THE SAN FRANCISCO BAY REGION

Having lived in Marin County, California, for a large part of the time since the year 1868, and still spending a good deal of time there, I am rather familiar with its faunal conditions. This county, just across the Golden Gate from San Francisco, is small, containing only 529 square miles of territory, and hilly. The southern half has a large proportion of brush and some timber land, but there are also extensive pasture lands that seem to be well adapted to the needs of the Douglas ground squirrel, *Otospermophilus grammurus douglasii* (Richardson), which has long been resident in the large county of Sonoma adjoining on the north.

During all of my dwelling and sojourning in Marin County, up to this summer (1931) only two or three ground squirrels have come to my notice there, and those promptly vanished. As set forth by Grinnell and Dixon, in a paper entitled "California Ground Squirrels" (Monthly Bull. State Comm. Hort. Calif., Vol. 7, 1918, p. 646), "Marin County seems to be devoid of any ground squirrels whatever except for a few *douglasii* along the Sonoma County border." This hiatus has existed in spite of the fact that ecologic conditions seem to be generally similar to those of Sonoma County, with the possible exception of a somewhat heavier rainfall in Marin and a greater frequency of the fog that so often rolls in from the ocean on summer evenings and that usually requires several hours of morning sun to dissipate.

At the present time certain conditions have changed; for many years past, a large part of the Pacific Coast of North America has been going through a period of diminishing rainfall, with the rainy season (November to April) of 1931 the lowest on record; springs and streams are sadly diminished, some entirely dried up, and the so-called water table is now far below the depth of normal fluctuation.

Coincident with this condition of drouth, the Douglas ground squirrel has this summer appeared in the southern part of Marin County and has spread to the very shore of San Francisco Bay. On August 24, 1931, from a point of vantage in the front end of a motor coach, I counted ten individuals along less than half a mile of track about four miles west of San Rafael. Three days later I saw four others, very recently run over by automobiles, on a short stretch of highway along the shore of Richardson's Bay (an arm of San Francisco Bay). In both instances the adjoining lands were open hillside pastures well adapted to the needs of ground squirrels.

Reports of reliable observers cover many other localities in central and southern Marin County, one of these observers being my brother, who frequently drives over the highways of the county, always on the lookout for anything of interest in the way of birds and mammals. So far, these reports do not show a heavy colonization, but such a wide distribution is certainly a serious menace, for natural enemies of this rodent are so scarce in this territory as to make possible a rapid and startling increase in population, provided other conditions are favorable. It will be a matter of interest for future observers to note whether return to normal rainfall will drive this squirrel back across its former borders, or whether it will adjust itself to conditions in the invaded territory.—JOSEPH MAILLIARD, *California Academy of Sciences, San Francisco, California.*

BATTLE BETWEEN PRAIRIE DOG AND RATTLESNAKE

Although many believe that prairie dogs and rattlesnakes live together in peace and harmony the fact is that in prairie dog country one of the chief foods of the rattlesnake is young prairie dog.

To witness a battle between these two creatures is unusual. Mr. W. F. Hardin of Phillips County, Montana, an employee of the U. S. Biological Survey, was fortunate enough to witness such an encounter. Mr. Hardin is the foreman of a crew of men engaged in eradicating prairie dogs which had become exceedingly destructive to the range grasses in Phillips County.

Mr. Hardin came upon the battling pair while engaged in the distribution of the poisoned oats. He stated that apparently the battle had been in progress for some time as the prairie dog's breast and entire front was covered with blood as a result of having been struck repeatedly by the rattlesnake. When first noticed the snake was coiled in typical rattlesnake fashion in the entrance of a rather high prairie dog mound. Mr. Hardin's attention was first attracted by the peculiar action of the prairie dog. The prairie dog would cautiously approach the burrow, advancing up the side of the mound until near the opening. Then it would suddenly dart forward, spring upward and back. Closer observation revealed that the upward and backward spring was caused by the snake striking. This attack by the prairie dog and defense by the snake was repeated several times while Mr. Hardin and one of his men were watching. As near as they could observe, the snake's fangs reached their mark each time. The movements of

the two were so rapid as the snake struck that it was difficult to follow them but on at least two occasions there was no question but that the snake struck the prairie dog.

Mr. Hardin states that the prairie dog was at a great disadvantage, the rattlesnake being in such a position that it could be approached from in front only. Also, being the aggressor, the prairie dog was compelled to climb the side of the mound at each attack. This gave the snake sufficient time to re-coil after striking. Neither one paid any attention to the men for some little time. Unfortunately the other members of the poison crew sensing that they were missing a show of some kind rode up too rapidly and broke up the fight. The prairie dog went down a burrow a short distance away seemingly quite ill while the snake was apparently unhurt.

This encounter took place on August 22, long after the young prairie dogs have come to the surface so that one cannot say that a mother prairie dog was attempting to protect her young.—O. E. Stephl, *U. S. Biological Survey, Bozeman, Montana.*

WHITE PRAIRIE DOGS FOUND IN MONTANA

While the writer was in Phillips County, Montana, in April, to arrange for carrying on some control work against prairie dogs, it was reported to him that white prairie dogs were to be found living together with the ordinary ones in one of the prairie dog towns. Later investigation showed that the white prairie dogs are present in T. 24 N., R. 32 E. over an area of less than 20 acres. Most of them appear to be concentrated on six or eight acres. Observers estimate that there are about twelve of the white specimens. On September 21, the writer saw one of the white prairie dogs on the surface. They are very conspicuous and also very wary. The poison crew foreman once saw two white prairie dogs at one burrow. Apparently they mate with the ordinary kind since the white prairie dogs are scattered throughout the town and occupy burrows with the yellow prairie dogs.

The presence of the white prairie dogs in this particular vicinity has been known to a number of local people for sometime. Old-timers say that they have been there for many years and that this is the only place, to their knowledge, where there are white prairie dogs. The writer has never heard of white prairie dogs being present elsewhere in Montana.

The poison crew purposely spared this prairie dog colony. One of the men, together with a government predatory animal hunter who lives in the vicinity, placed traps for the white prairie dogs. To date four of them have been taken alive. The government hunter has three of these together with one or two of the ordinary kind. Mr. Hardin, our foreman, has the other together with one of the ordinary kind.

The writer saw the captive white prairie dogs. Their pelage is not as coarse as that of the common prairie dog. The tip of the tail is brown instead of black. The eyes are black. Otherwise the white prairie dogs appear to be normal. Those in captivity were large and powerful and put up the same fight when cornered that the yellow prairie dogs do.—O. E. Stephl, *U. S. Biological Survey, Bozeman, Montana.*

SQUIRREL DAMAGE TO YOUNG REDWOOD TREES

One of the larger of the native squirrels, *Sciurus griseus griseus* of the California redwood region, is responsible for no inconsiderable damage to second-growth redwood timber. The squirrels operate in the early spring when the cambium has been stimulated to action and the region just under the bark is apparently more palatable to them than at other times. They strip the bark from the upper trunk, usually at a point where the diameter is over two inches and under ten inches. The strips are narrow, not over one inch wide, and vary in length from about four inches to over twelve inches. As soon as the bark is removed the squirrel scrapes off the succulent layer from the exposed wood. Stems of small diameters, four inches or less, are often completely girdled. On larger stems the girdling is usually incomplete and the wound eventually heals.

When completely girdled, the top of the tree dies although it may later be replaced by a supplementary top. If the tree was originally of the dominant crown class, the loss of its top places it in a lower class with a consequent loss of growth increment on the most desirable trees. When the injury is incomplete the wound heals over rapidly but a permanent scar remains in the wood and decay often gains entrance before healing is completed. Some trees have been found that were evidently attacked a half dozen times or more by these squirrels, and the cross sections show a number of crescent-shaped defective areas that materially reduce the value of the lumber.

During an investigation by the author of the growth of second-growth redwood and the character of its lumber, the defects due to the squirrel work were found to be abundant enough to warrant investigation of the cause of the injury. At first it was thought that porcupines were responsible, but this animal does not exist in the region. That the damage is the work of squirrels is now beyond doubt. The tooth marks on the wood were identified as those of the California gray squirrel by Dr. Joseph Grinnell, of the University of California. Mr. Wade Sturgeon of Occidental, California, reports having watched the squirrels on several occasions at work stripping off the bark and gnawing the wood of sapling sprouts, while the author has noted abundant other evidence of the connection between this work and the squirrel named. This squirrel was greatly reduced in numbers about 1910 and because of this was put under protection by the State Legislature. Under protection the species is again multiplying rapidly, particularly in Sonoma and Mendocino Counties, California, and may become a factor to be reckoned with in the reforestation of cut-over redwood lands.—Emanuel Fritz, *Associate Professor of Forestry, University of California, Berkeley, Calif.*

EXTENSION OF THE RANGES OF THREE POCKET GOPHERS IN SOUTHERN CALIFORNIA

Recent field work in the Mohave Desert region by Mr. George G. Cantwell, of the Los Angeles Museum staff, to secure additional data on the pocket gophers of southern California has resulted in the acquisition of new knowledge on the ranges of three races of the genus *Thomomys*.

The range of *Thomomys bottae pallescens* in Los Angeles County east from the eastern edge of the Santa Clara Valley is shown by specimens from the following localities: Mint Canyon, two miles east of Saugus, 4; Mint Canyon, fifteen miles east of Saugus, 6; Mint Canyon, six miles west of Palmdale, 5; Palmdale, 10, one of which is albinistic; Llano, 2 (from the collection of Jack C. von Bloeker, Jr.).

The range of *Thomomys perpallidus mohavensis* west of Victorville, San Bernardino County, California, in Los Angeles County is shown by specimens as follows: Llano, 19 (11 from the collection of Jack C. von Bloeker, Jr.); Little Rock, 17.

The acquisition of a typical specimen of *Thomomys perpallidus perpes* from Rosamond, Kern County, California, establishes, in so far as is known, the southernmost station for that race. The specimen, no. 1420 Los Angeles Mus., adult female, collected December 11, 1929, by George G. Cantwell, measures: Total length, 210 mm.; tail vertebrae, 60 mm.; hind foot, 27 mm.

The writer is indebted to Dr. J. Grinnell for identifying the specimens from the collection of the Los Angeles Museum.—Jack C. von Bloeker, Jr., *Los Angeles Museum, Exposition Park, Los Angeles, California.*

REMARKS ON GEOMYS BURSARIUS ILLINOENSIS KOMAREK AND SPENCER

Through the kindness of Mr. Don A. Spencer, in the summer of 1930, I was advised of an abundance of pocket gophers in the vicinity of Lake Village, Newton County, Indiana. On July 30 and 31, 1930, I visited the locality and along with Messrs. Paul Hickie and Thomas Harrison, using special traps kindly lent me by Mr. Spencer, secured three specimens, two from Lake Village and one from near Roselawn. On August 1, Hickie and Harrison secured an additional specimen from near Roselawn. Photographs of the animals and their working were shown to Mr. Charles C. Deam who later advised me by letter that pocket gopher mounds were to be found plentifully just south of Fair Oaks, Jasper County. On July 3 and 4, of 1931, Mr. William Engels, my wife and I drove over from South Bend to Fair Oaks to secure additional specimens. Our first sight of pocket gopher workings was along the road four miles east and four miles south of Rensselaer. One No. 1 steel trap was placed there and one animal taken that same evening. So far as I am aware, this is the eastermost specimen of *Geomys bursarius illinoensis* Komarek and Spencer (Journ. Mamm., vol. 12, p. 405, Nov., 1931.) Later we saw some workings a few miles farther east but still within Jasper County. None were seen in White County. Later in the same day and early the next morning, Mr. Engels and I took four more specimens at Fair Oaks, where we found them common. All five 1931 specimens are now in the University of Notre Dame, and the four 1930 specimens are in the University of Michigan.

All these specimens are slate-gray in color as described by Komarek and Spencer. This fact was observed by me in 1930, as well as by Hickie and Harrison, but knowing that Komarek and Spencer were working on Illinois-Indiana pocket gophers, we did not investigate the matter other than to notice that Baird, in 1857, had called attention to a plumbeous phase (Mammals of North America, p. 374, and table p. 377, 1857). In this table four Illinois specimens: 2633, S. Illinois; $\frac{614}{1760}$, Illinois; 1882, Jacksonville; and $\frac{780}{1882}$, Tremont are all listed as "black" instead of "red" as mentioned for the west of the Mississippi specimens. Kellogg writes me that no. 2633 (presumably an alcoholic specimen) is missing and that no. 1882 is listed in the catalogue of the Division of Mammals as an elk from Medicine Bow Butte. The other specimens are in the United States National Museum. On page 374 in describing the Morgan County, Illinois specimens, Baird mentions several cranial and dental characters of the plumbeous

variety and concludes the paragraph with these significant words, "If these differences are constant in many specimens, there will be no danger in separating the lead-colored ones as distinct." It is interesting to see the keen observations of Baird verified by Komarek and Spencer nearly 75 years later.

The earliest record for the State of Indiana for *Geomys bursarius illinoensis* is that of Evermann and Butler (Proc. Ind. Acad. Sci., vol. 3, 1893, p. 126, 1894) who report it for Newton County. Another interesting early record is in a historical work by T. H. Ball, "Northwestern Indiana from 1800 to 1900" page 448, published in 1900. The animal is here called *Geomys pinctis*, an obvious misprint for Rafinesque's *Geomys pinetis*. It is reported as occurring in Newton and Jasper Counties. Hahn (Mammals of Indiana, p. 529, 1909) definitely reports it from Shelby, Lake County. He had no specimens and as this is north of the Kankakee River the observation needs verification. Mr. Galen C. Oderkirk has kindly sent me a photograph of a field in northwestern Tippecanoe County, Indiana, showing numerous pocket gopher's mounds. No specimens have been taken from them so far as I am aware.

In Cory's Mammals of Illinois and Wisconsin, page 243, 1912, a specimen of pocket gopher is listed from St. Joseph County, Indiana. This is a so-called "red" skin without skull, in the Field Museum of Natural History. It was received through exchange from the American Museum of Natural History many years ago. I have examined the original entry in the catalogue of the latter museum and the record has been changed, probably by Dr. Merriam, himself, from St. Joseph County to Elk River, Minnesota. I doubt if pocket gophers occur in either St. Joseph or Starke Counties, Indiana. I have travelled over many miles of by-roads in these counties accompanied by Mr. Engels and my wife and we have never seen any evidences of their working, though numerous suitable locations similar to those seen in Jasper and Newton Counties exist.—Marcus Ward Lyon, Jr., *South Bend, Indiana.*

NORTHERN EXTENSION OF THE RANGE OF ONYCHOMYS TORRIDUS RAMONA RHOADS

Dr. Joseph Grinnell (Proc. Calif. Acad. Sci., ser. 4, vol. 3, pp. 302–303), gives the range of *Onychomys torridus ramona* as,—"from the Mexican line northwest at least to San Fernando Valley, Los Angeles County." It may be worthy of record, therefore, that on February 20, 1931, Mr. George G. Cantwell, of the Los Angeles Museum staff, secured an adult male in Mint Canyon, six miles west of Palmdale, Los Angeles County, California. This may also constitute an eastern extension record. The new locality is approximately thirty miles northeast of San Fernando. The specimen, no. 2219, Los Angeles Mus., measures as follows: Total length, 140 mm., tail, 48 mm., hind foot, 20 mm.—Jack C. von Bloeker, Jr., *Los Angeles Museum, Exposition Park, Los Angeles, California.*

FURTHER NOTES ON TRAVELS OF PEROMYSCUS

In the Journal of Mammalogy for August, 1931 (Vol. 12, No. 3, pp. 200–209) we published the results of a study of the movements of *Peromyscus maniculatus artemisiae* in the area about Whetstone Creek, Teton Co., Wyoming. Further trapping was done in this same area in the fall of 1931, yielding results of sufficient interest to add to the data obtained the previous year.

Beginning Sept. 9, 1931, four days were spent on Whetstone Creek and trapping

was carried on over an area about 400 yards by 300 yards, the same place trapped the previous summer, in order to learn if possible whether any of the marked mice still remained.

About 70 snap traps were used. The first night 33 mice were taken, second night 37, third night 41, fourth night 21. A total of 132 mice were taken in four days on an area where 135 were taken the previous summer with much more trapping. Indications are that most of the mice on this area were trapped during the four nights. Although many mice had been removed from this place the previous summer the population had completely recovered. In the fall of 1930 there were only 42 marked mice potentially on the area (excluding those which had been released a mile or more distant).

Of the 132 mice taken in 1931, 21 were probably adult, although a few of these could almost be classed as sub-adult. Of these 21 adults 5 had been marked the previous year, a rather high percentage of the total number of adults.

History of the marked mice taken in 1931

No. 93. ♀, immature when marked on August 31, 1930. In 1930 this mouse was released about 2,000 yards north of place of capture. On Sept. 11, 1931, it was retaken about 100 yards north of spot where first taken. It had returned over a mile to reach its home range.

No. 116. ♀, adult on Sept. 7, 1930. Captured on Pacific Creek, 4 miles south of area under discussion; released on the area, Sept. 7 and recaptured Sept. 10, 1930, at same place. In 1931, a year later, it was retaken about 200 yards south of place of release in 1930. This mouse, transported four miles from its home range, had remained a year in the new locality, where it had been released.

No. 147. ♀, sub-adult on Sept. 12, 1930. Released where first taken and recaptured Sept. 17, 1930, 75 yards away. Recaptured about a year later, Sept. 10, 1931, midway between the two places of capture in 1930. This mouse had remained closely on its old home range.

No. 148. ♂, immature on Sept. 17, 1930. Released where captured in 1930. Retaken on Sept. 12, 1931, at exactly the same spot where taken in 1930—another mouse clinging closely to its home range.

No. 157. ♀, sub-adult on Sept. 17, 1930. Released at place of capture in 1930. Retaken Sept. 10, 1931, about 40 yards from place where captured and released the previous year.

The history of these five mice points to a long continued, definite home range. No. 93, which had returned over a mile to its original home range, gives us another instance of the ability of these mice to find their way over a long distance to the original place of capture.—O. J. Murie and Adolph Murie.

IDAHO PYGMY RABBIT: BRACHYLAGUS IDAHOENSIS (MERRIAM)

While driving along the road near Promontory, Boxelder Co., Utah, July 22, 1931 (6 P.M. and hot), we saw a small dark animal scurry into the sagebrush. We stopped, peered eagerly about and finally Mr. Stevens shot it. A few miles farther on I secured another, shooting it from the car as it sat on the edge of a burrow. The following morning we got a third pygmy rabbit very near the place where the first one was taken. One or two others were seen.

We looked in vain for the white on the tail of this cotton-tail-like rabbit. Its

gait was noticeably more squirrel-like than rabbit-like, scampering along close to the ground without the characteristic bounds of the more common rabbits.

I believe this is the first record of this species in Utah.—J. S. STANFORD, *Utah State Agricultural College, Logan, Utah.*

BIRTH DATE OF MULE DEER FAWNS

The authorities that I have read on the subject state that the mule deer fawns of the west are born at any time between the middle of May and the middle of June, but on July 30, 1930, while working down the Middle Fork of the Gila River in the Mogollon Mountains, in southwestern New Mexico, with a pack outfit, we came upon two mule deer fawns lying close to the trail. These fawns at the most were but a few days old and acted exactly as do very young white tail fawns in the Adirondacks. They remained motionless with the exception of one that wriggled its nose. Mr. Edward S. Steele, a predatory mammal hunter who traps in these mountains, tells me that these fawns are dropped at any time between the latter part of June and the last of July. This latter date would fit in with the fawns we found. Can it be that in this altitude, with the peaks reaching better than 9000 feet, the birth date is set back?—CHARLES A. GIANINI, *Poland, N. Y.*

FISH-EATING DEER

In the February, 1924, issue of the Journal of Mammalogy (pages 64–65), is an article on fish-eating deer by Thornton W. Burgess, of Springfield, Mass. In this article Mr. Burgess tells of deer in the Maine woods stealing trout from his camp. Although he did not actually see the deer taking fish, he had every reason to believe, from tracks and other signs, that such was the case. He mentions an instance in which a companion reported seeing a deer take fish from a canoe but gives no actual first hand experiences of his own. He draws the conclusion that the deer hanging around the Maine camps have perhaps developed a taste for fish offal on account of the salt in it.

According to Mr. Burgess: "The question is, just how generally are deer eaters of fish? Probably the liking for fish is an acquired taste confined to a few individuals. My own theory of the matter is that these particular animals had hung around camps picking up scraps of food and in this way had probably eaten some cooked fish for the sake of the salt. In this way, they had acquired a taste for fish for its own sake. Of course this is pure speculation but it seems to me the most logical explanation."

The longer one observes animal life and the specific reactions of the individual as compared with that of the group, the less is one sure that individual behavior can ever be depended upon. Although the majority of individuals of a known group will react much alike under average conditions, it becomes increasingly apparent that one can never tell what certain individuals may or may not do. Whether or not deer eat fish habitually is a question still far from settled, but the experience I am going to relate took place far from civilization and camps, in an area of wilderness where the animals in question could not have possibly developed an appetite in the way suggested by Burgess. In this case it was purely a natural reaction, a case of an animal or a number of animals willfully varying their natural vegetable diet with fish.

On May 22, 1927, I was paddling down Cecil Lake in the Quetico Provincial

Park of Ontario on my way to Lake McIntyre. It was about noon when I noticed in a small bay a short distance ahead, a doe and a fawn. Approaching carefully, I discovered that both animals were standing in the rocky bed of a small creek flowing out of the lake at that point. Fortunately, I was perfectly screened from their view by a dense reedy point, so was able to paddle to within forty feet without being seen. I might explain that it was the season of the year when the black suckers, *Catostomus commersonii*, were running up the small streams to spawn. This particular creek was so shallow that the suckers, which I could plainly see, were throwing themselves clear out of the water in order to get up the rocky bed of the stream.

The doe was busily stamping around and to my surprise I saw that she was doing her utmost to impale some of the suckers with her fore feet. Finally she succeeded in killing one and immediately took it up in her mouth. While the fish was still flopping strongly she oriented it as any fish-eating animal would do, and munched it down head first in the same identical fashion she would manipulate a clump of grass. The fawn made no effort whatever to eat any fish or trample on them but gambolled up and down the creek while its mother was feeding. The sucker eaten was about fourteen inches in length. No sooner had the tail of the first fish disappeared, than the doe began trying to get another. This was not difficult because there were dozens of suckers of all sizes flopping and jumping around her feet. In a short time she had trampled another, picked it up in her mouth and begun chewing at the head end. Just about that time, she noticed me, gave a startled leap and disappeared into the brush still holding the sucker in her mouth.

Pushing ashore at the source of the creek, I found tracks which indicated that not only had the doe been there repeatedly but that other deer, among them a huge buck, had been there within the last twenty-four hours. This particular place was not a drinking hole, nor was it a spot to which deer would come for the aquatic vegetation of which they are fond. The only excuse for their coming at all must have been to obtain the fish.—Sigurd F. Olson, *University of Illinois, Urbana, Ill.*

THE TYPE LOCALITY OF BALAENA CISARCTICA COPE

When the late Dr. F. W. True was preparing his "Whalebone Whales of the Western North Atlantic" he spent some time at the Academy of Natural Sciences in Philadelphia studying and photographing the several whale types in the museum, in which task the writer was associated with him. When the monograph appeared in print I was surprised to find that he had given as the type locality for Cope's *Balaena cisarctica*, "Opposite Philadelphia, on the coast of New Jersey." The large label which was placed on the skeleton when it was mounted clearly stated "Delaware River opposite Philadelphia," and the only explanation that I can offer for True's misstatement is that he probably had the locality correct in manuscript and that either he or someone who read the proof inferred that an error had been made and altered it as above. I intended to correct this error long ago but find that I failed to do so.

In this connection it may be of interest to republish here a letter that appeared in the Philadelphia "Evening Bulletin" of November 2, 1928, signed "Kensington Boy," which describes the arrival and capture of the specimen:

"Relative to the Whale that came up the Delaware river in 1860 I well remember the event. It was in the summer of 1860, I was sitting on a pier at the foot of Shackamaxon street that Sunday morning as the whale passed up the river, spouting huge columns of water, then submerging and coming to the surface again, each time spouting water into the air.

"It proceeded up the river and when it reached Clearfield street (Port Richmond) it turned towards the shore, submerged and ran under a raft, where it grounded. A number of persons collected, some with shot-guns, rifles and revolvers. It subsequently backed out, as it was flood tide at the time, and swam up the river.

"The next day it reappeared off the Port Richmond coal piers, followed by a flotilla of river craft. A cook on a coasting schooner anchored in the river put off in a yawl, armed with a harpoon. He was an old whaler, and with one thrust struck the whale in a vital spot. A tug boat was summoned and the whale was towed to Matt Sanderson's marine railway at the foot of Hancock street where Penn Treaty Park is now located.

"Arrangements were made with the owner of the railway to haul the monster out, a shed was erected over it, and an admission of twenty-five cents was charged to view it. Thousands of persons from all parts of the city and surrounding cities came to see it. The red horse-cars on the Richmond line had their sides placarded with large signs, 'Direct to the Whale.'

"After a few days the odor became so strong that the whale was split down the back and sawdust mixed with tar was placed in the incision and allowed to smoulder after it had been set on fire.

"It was subsequently taken off the railway and towed to E. A. Landell's oil refining place, which was located immediately above the Kensington Screw dock, just below Shackamaxon street. A large pair of shores was used to hoist the whale partly out of the water, the blubber was removed and then the carcass was towed to the bar at the south end of Petty's Island. There it was stripped of all flesh and the skeleton taken to the Academy of Natural Sciences, where it now is."

The skeleton was presented to the Academy by George Davidson at a meeting held July 2, 1861, when the whale was referred to as having been "recently caught in the Delaware River." It was probably mounted shortly afterward, as Cope refers to it as exhibited in the Museum when he described it in 1865 (Proc. Acad. Nat. Sciences Phila., 1865, pp. 168–169); the present writer remembers it as a mounted specimen when, as a boy, he visited the old Museum of the Academy at Broad and Sansom Streets in 1874.—WITMER STONE, *Academy Natural Sciences, Philadelphia.*

RECENT LITERATURE

Zuckerman, S. THE SOCIAL LIFE OF MONKEYS AND APES, pp. xii, 375, pls. 24. International library of Psychology, Philosophy and Scientific Method. Kegan Paul, Trench, Trubner, & Co., London, 1932 (= December, 1931). Cloth, 10 s. 6 d.

At a time when so many humanized accounts of mammals and their ways are encumbering the literature of natural history, and leading students of human social tendencies into strangely devious bypaths, it is a pleasure to read such a book as Mr. Zuckerman's Social Life of Monkeys and Apes. In his preface the author, who is anatomist to the Zoological Society of London and demonstrator of anatomy, University College, London, clearly sets forth his point of view: "I do not claim to have given a complete account of the social lives of the animals which I studied, but, so far as I could, I have considered all the available and relevant facts. My own observations have been made without, I hope, anthropomorphic bias, and my interpretations have been weighted with no more than the insistence of the facts themselves. I have approached the subject from the deterministic point of view of the physiologist, treating overt behavior as the result or expression of physiological events which have been made obvious through experimental analysis." Thus oriented he proceeds to discuss a mass of material whose scope and interest can be inferred from the chapter headings: 1, Human sociology and the sub-human primates; 2, Mammalian sociology; 3, Sexual periodicity; 4, The breeding season and society; 5, The physiology of the reproductive processes of mammals other than primates; 6, The general character of the menstrual cycle; 7, The morphology, physiology, and interpretation of the menstrual cycle; 8, The oestrous cycle and behavior; 9, The menstrual cycle and behavior; 10, The individual within the group; 11, Apes and monkeys in the wild: general; 12, Baboons in South Africa; 13, The social groups of wild apes and monkeys; 14, The hamadryas baboon colony; 15, Dominance and the liberation of sexual responses; 16, The communal life of the baboon; 17, The development of social and sexual responses; 18, Altruism and society; 19, The social scale.

The book includes a compact summary of the widely scattered literature in which the recent studies of non human primate physiology and psychology has been recorded and also a particularly instructive account of the author's own observations on wild chacma baboons in South Africa and on a colony of captive hamadryas baboons in the London Zoological Gardens.

In conclusion Mr. Zuckerman offers some generalizations, the more interesting of which are these: that group formations among apes and monkeys have their starting point in the continuous attractiveness of the females to the males (a condition peculiar to primates); that the social organization within these groups depends on individual dominance, of which the non-human primate harem is only a special form or instance; that the human family organization may have changed from the original primate harem type to the monogamous type that "most authorities" regard as the family unit of man at its lowest human level, under the influence of necessities imposed by the demands of man's omnivorous diet. "Primitive man, who . . . was an animal largely dependent upon a diet of meat, would not have gone hunting if in his absence his females were abducted

by his fellows. Reason may have forced the compromise of monogamy" (p. 316). This last suggestion is wisely put forward under the qualification: If reason played a part . . .

There is an index of mammalian species mentioned in the book, an index of authors and subjects and a bibliography containing 402 titles. The plates are excellent photographs of captive hamadryas baboons.—G. S. MILLER.

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CORRESPONDENCE

TO THE MEMBERS OF THE AMERICAN SOCIETY OF MAMMALOGISTS

Editor, Journal of Mammalogy:

We have all been looking forward to the publication of a cheaper edition of Seton's "Lives of Game Animals." This edition finally appeared for $40. Even at this price many of us have hesitated and delayed the purchase.

Through an arrangement with Doubleday, Doran and Company the American Society of Mammalogists has permission to purchase a number of sets for $15 plus shipping charges. This price is only for our members and the privilege must not in any way be violated.

In order that this offer may remain in force sets must be sold in quantity. Therefore, if you plan to obtain this reference work, this is the time to order it, in order to maintain the special price to members.

Remittance should be made payable to O. J. Murie, Chairman, and mailed to me at Jackson, Wyoming. The books will then be shipped directly from the publishers, shipping charges collect.

O. J. Murie, *Chairman,*
Committee on Life Histories
and Ecology.

COMMENT AND NEWS

The Roosevelt Memorial Association, New York, has awarded a Roosevelt medal to Dr. C. Hart Merriam, Chief of the Biological Survey from its inception in 1885 to 1910, and since, Research Associate of the Smithsonian Institution.

The President of the American Society of Mammalogists transmits for publication with the consent of Doctor Merriam the following communication from this distinguished past president of the society.

Washington, D. C.
November 10, 1931

Dr. M. W. Lyon Jr.
The Clinic
South Bend, Ind.

Dear Dr. Lyon:

I am sure I feel the same way you do about the unhappy attitude of certain Naturalists in regard to the discord—to use a very mild word—as to the wholesale use of poisons in destroying alleged noxious animals. The difference between the Biological Survey men and most Naturalists outside the Survey strikes me as one of *degree*. Most of us believe that in certain places and at certain times it is highly desirable to destroy harmful animals, but when it comes to employing upward *of three hundred men* to distribute poisons broadcast over vast areas, I must confess that my sympathy is with the animals. But you exaggerate my influence in thinking that I might "effect a reconciliation."

As I look at the matter, the fight is between the stock men, who have *enormous* influence in Congress, and the rest of us, who have *no influence at all*.

Just why the Government should force *all* the States to pay the cost of poisoning alleged injurious animals in *one third of the States*, is beyond my comprehension.

I have long felt that this is a *State* affair and that such trapping and poisoning as may be necessary should be paid for by the *States concerned, not* by the United States as a whole.

Very truly yours,
(Signed) C. HART MERRIAM.

The Treasurer's Report by J. Forest Walker of Montgomery County, Maryland, which covers the fiscal year July 1, 1930 to June 30, 1931, inclusive, as required by section 2, chapter 171, Acts of General Assembly of Maryland of 1906, contains some interesting statistics on the destructiveness of dogs. The disbursals for dog damage to live stock and poultry in this one County amounted to $5,351.05. Examination of the list of damages paid to individuals for losses caused by other peoples' dogs shows that sheep were killed in 60 instances, hogs and pigs in 11, cattle in 7, turkeys in 81, and chickens in 39. (The Maryland News, Friday afternoon, November 29, 1931, p. 10.)

ANNOUNCEMENT OF ANNUAL MEETING

The fourteenth annual meeting of the American Society of Mammalogists will be held at the United States National Museum, Washington, D. C., from Tuesday, May 3, to Saturday, May 7, 1932. Headquarters will be at the Hotel Washington. Titles and furthur particulars regarding papers for presentation should be in the hands of the Corresponding Secretary not later than March 31. It will be necessary to limit papers to twenty minutes, save in the case of special features employing motion pictures. Further details regarding the meeting may be obtained from the Corresponding Secretary, or from the Local Committee on Arrangements: Wm. M. Mann, chairman; Walter C. Henderson, H. H. T. Jackson, Remington Kellogg, and Ernest P. Walker.

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